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FINAL

PHASE I RFI/RI WORK PLAN

ROCKY FLATS PLANT
ORIGINAL PROCESS WASTE LINES
(OPERABLE UNIT 9)

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

ENVIRONMENTAL RESTORATION PROGRAM

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Approved By

______________________ __/__/__
Work Plan Manager (Date)

______________________ __/__/__
Division Manager (Date)

Effective Date: ____________________

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LIST OF ACRONYMS

AEC	U.S. Atomic Energy Commission
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criteria
BCF	bioconcentration factor
BRA	Baseline Risk Assessment
CAD	Corrective Action Decision
CCR	Colorado Code of Regulations
CDH	Colorado Department of Health
CDOW	Colorado Department of Wildlife
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLP	contract laboratory program
CMS	Corrective Measures Study
COC	contaminants of concern
CRP	Community Relations Plan
CWA	Clean Water Act
CWQCC	Colorado Water Quality Control Commission
DCN	document change notice
DMC	derived media concentrations
DOE	U S Department of Energy
DRCOG	Denver Regional Council of Governments
DQO	data quality objective
EE	Environmental Evaluation
EER	Environmental Evaluation Report
EEWP	Environmental Evaluation Work Plan
EG&G	EG&G Rocky Flats, Inc
EIS	Environmental Impact Statement
EM	Environmental Management
EMD	Environmental Management Division
EPA	U.S Environmental Protection Agency
ER	Environmental Restoration
ERDA	Energy Research and Development Administration
ESA	Endangered Species Act
FID	Flame Ionization Detector
FIDLER	Field Instrument for Detection of Low-Energy Radiation
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FS	Feasibility Study
FSP	Field Sampling Plan
FWCA	Fish and Wildlife Coordination Act
FY	fiscal year
GPR	ground penetrating radar

LIST OF ACRONYMS
(Continued)

GRRASP	General Radiochemistry and Routine Analytical Services Protocol
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HRR	Historical Release Report
HSP	Health and Safety Plan
HSU	hydrostratigraphic unit
IAG	Interagency Agreement
IHSS	Individual Hazardous Substance Site
IPPCD	Interim Plan for Prevention of Contaminant Dispersion
IRIS	Integrated Risk Information System
MATC	maximum allowable tissue concentration
MBTA	Migratory Bird Treaty Act
MCL	Maximum Contaminant Level
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NRDA	Natural Resource Damage Assessment
OP	Operating Procedure
OPWL	Original Process Waste Line
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PARCC	precision, accuracy, representativeness, completeness, and comparability
PA	Protected Area
PCB	polychlorinated biphenyl
PCN	Procedure Change Notice
PID	Photoionization Detector
PPCD	Plan for Prevention of Contaminant Dispersion
PQL	Practical Quantitation Limit
PRP	Potentially Responsible Party
QA	Quality Assurance
QAA	Quality Assurance Addendum
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RAAMP	Radiological Ambient Air Monitoring Program
RAGSEEM	Risk Assessment Guidance for Superfund Environmental Evaluation Manual
RAS	routine analytical services
RCRA	Resource Conservation and Recovery Act
RfD	risk reference dose
RFEDS	Rocky Flats Environmental Database System
RFI	RCRA Facility Investigation
RFP	Rocky Flats Plant

LIST OF ACRONYMS
(Continued)

RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RSP	Respirable Suspended Particulate
SAS	special analytical services
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SEAM	Superfund Exposure Assessment Manual
SSH&SP	Site Specific Health and Safety Plan
SWMU	solid waste management unit
TAL	Target Analyte List
TBC	To Be Considered
TCA	trichloroethane
TCE	trichloroethylene
TCL	Target Compound List
TIC	tentatively identified compound
TOC	total organic carbon
TSCA	Toxic Substances Control Act
VOC	volatile organic compound
WSIC	Waste Stream Identification and Characterization
WSRIC	Waste Stream and Residue Identification and Characterization
WQC	Water Quality Criteria
WQCC	Water Quality Control Commission

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EXECUTIVE SUMMARY

This document presents the Work Plan for the Phase I RCRA Facility Investigation/Remedial Investigation (RFI/RI) of Operable Unit No 9 (OU9) at the Rocky Flats Plant (RFP), Jefferson County, Colorado This Work Plan includes a Field Sampling Plan (FSP) to investigate the presence or absence of contamination at Individual Hazardous Substance Site (IHSS) 121, the Original Process Waste Lines (OPWL) The OPWL is a largely abandoned network of tanks and underground pipelines used for transport and temporary storage of aqueous process waste from RFP production activities The FSP presented in this Work Plan is based on the requirements of the Interagency Agreement (IAG) amongst the U S Department of Energy (DOE), the U S Environmental Protection Agency (EPA), and the State of Colorado

As required by the IAG, this Phase I RFI/RI Work Plan addresses characterization of source materials and soils at OU9 A subsequent Phase II RFI/RI will investigate the nature and extent of surface water, ground water, and air contamination and evaluate potential contaminant migration pathways OU9 source materials and soils include the OPWL tanks and pipelines and surrounding soils potentially affected by releases from the OPWL For purposes of this Work Plan, "soils" is defined as vadose-zone (i.e., unsaturated) surficial deposits, as well as bedding and backfill materials (e.g., sand, gravel, native soil) in pipeline trenches and around underground tanks

The initial step in the development of this Work Plan was to review available existing information on the OPWL This information was used to characterize the site physical conditions and to develop a conceptual model of contaminant fate and mobility that identifies potential exposure pathways at OU9. Based on this characterization, Data Quality Objectives (DQOs) were developed to describe the quality and quantity of data required by the RFI/RI Through application of the DQO process, site-specific RFI/RI goals and data needs are established. These site-specific goals are developed within the broad framework of characterizing OU9 source materials and soils.

The Work Plan is organized as follows.

- **Section 1.0** of this Work Plan provides introductory information and a general characterization of the RFP region and site.
- **Section 2.0** presents a description of the OPWL and OPWL site physical conditions, including available information on the history of the unit and a conceptual model of contaminant fate and mobility This initial characterization provides the basis for establishing data needs, Data Quality Objectives (DQOs), and developing the FSP for the OPWL
- **Section 3.0** presents a preliminary identification of Applicable or Relevant and Appropriate Requirements (ARARs) for OU9
- **Section 4.0** establishes data needs and DQOs considering the site characteristics and conceptual model provided in Section 2 0
- **Section 5.0** outlines Phase I RFI/RI tasks to be performed
- **Section 6.0** presents a preliminary schedule for implementation of the Phase I RFI/RI
- **Section 7.0** presents the FSP for the Phase I RFI/RI to satisfy the data needs and DQOs outlined in Section 4 0
- **Sections 8.0 and 9.0** provide the Human Health Risk Assessment Plan and the Environmental Evaluation Work Plan components of the Phase I Baseline Risk Assessment Plan, respectively
- **Section 10.0 and 11.0** describe the Quality Assurance Addendum and Environmental Management Division Operating Procedures and Revisions, respectively
- **Section 12.0** provides a list of references.

In addition, the following appendices are provided:

- **Appendix A** compiles fifteen detailed Site Utility Location Maps which highlight the OPWL network and other nearby utilities.

- **Appendix B** summarizes available data for each of the known tanks and pipelines in the OPWL system

- **Appendix C** provides three OPWL reference documents that are considered representative of the available data for the unit

- **Appendix D** contains available geologic and analytical data for RFP monitor wells and borings located in the vicinity of the OPWL, and includes monitor well and boring location maps for reference

- **Appendix E** contains field notes relevant to site accessibility including physical obstructions and security restrictions

Approved By.

______________________ __/__/__
Work Plan Manager (Date)

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Division Manager (Date)

Effective Date ______________

2.0 SITE CHARACTERIZATION

OU9 targets IHSS 121, the Original Process Waste Lines (OPWL) The OPWL is a network of pipelines and tanks which extends throughout much of the RFP main production complex (Figure 2-1). As currently defined, the unit consists of 35,000 feet of underground pipelines and 39 tank locations containing a total of 65 tanks The area under investigation in the OU9 Phase I RFI/RI includes areas in close proximity to the OPWL pipelines and tanks, and areas from which OPWL pipelines and tanks have been removed

2 1 REGULATORY HISTORY

The OPWL was first identified as a RCRA regulated unit in mid-1986 Shortly thereafter, an interim status Closure Plan for the OPWL ("Closure Plan") was prepared (DOE, 1986b) pursuant to Part 265 of the Colorado Hazardous Waste Regulations (6 Colorado Code of Regulations [CCR]) and Title 40, Part 265 of the Code of Federal Regulations (40 CFR), and in accordance with the Compliance Agreement for RFP finalized by representatives of DOE and EPA on July 31, 1986 The Closure Plan was revised in late 1988 (DOE, 1988)

In late 1986, Phase I of the DOE CEARP program (Section 1 3 2) was performed at RFP The CEARP investigations were initiated to characterize RFP release sites, including the OPWL

On January 22, 1991, DOE, EPA and the State of Colorado entered ınto a Federal Facılıty Agreement and Consent Order, commonly known as the IAG. The IAG establıshes the work and schedule for the RFI/RI and Correctıve Measures Study/Feasıbılıty Study (CMS/FS) response process at RFP OU9 currently ıs in the Phase I RFI/RI stage. As defined in the IAG, the Phase I RFI/RI ıs requıred to characterize sıte sources and soils (DOE, 1991a).

2 2 UNIT DESCRIPTION AND OPERATIONAL HISTORY

The descnptıons of OPWL physıcal charactenstıcs, operatıng hıstory and current status provıded ın thıs Work Plan are drawn pnmanly from the Closure Plan (DOE, 1988) The Closure Plan summanzed the fındıngs of prevıous studıes and compıled new ınformatıon on the unıt through lıterature searches, ınterviews wıth RFP employees, and a computer search of RFP drawings The lıterature search ıncluded

- A 1986 Rocky Flats Underground Storage Tank report (Rockwell, 1986f)
- A 1976 study of the OPWL performed by Rockwell Internatıonal (Appendıx C, Document C-2)
- A 1985 RFP conceptual design report for envıronmental ımprovement projects, whıch dıscusses the OPWL (Appendıx C, Document C-1)
- Mıscellaneous reports, letters, and memoranda available in the RFP Environmental Master Fıle

RFP employees who were contacted and ınterviewed for the Closure Plan ıncluded buıldıng supervısors famılıar wıth the operatıon of the systems wıthın theır respectıve buıldıngs, health physıcs personnel famılıar wıth health and safety monıtorıng at Rocky Flats, and other employees wıth a general knowledge of the OPWL

A computer search of catalogued drawıngs, usıng key words in the drawıng tıtle, was also performed. The applıcable drawıngs ıncluded sıte utılıty locatıon maps (see Appendıx A) as well as plans and specıfıcatıons for removal and abandonment of OPWL pıpelınes and tanks (DOE, 1988)

It was originally intended that the Closure Plan would provide all information necessary to characterize the OPWL. While the Closure Plan provides information useful for general understanding of the OPWL, it became apparent during preparation of this Work Plan that the available information is not sufficient for planning a detailed investigation of the unit Following the completion of the June 1990 draft OU9 Phase I RFI/RI Work Plan, additional data were compiled to more clearly define the history and status of OPWL tanks These data were presented in a separate data compilation report (DOE, 1991c) which is fully incorporated into this Work Plan (see Section 2.2 3 and Appendix B) The results of the data compilation indicated that much of the previously existing information on the OPWL tanks was outdated or incomplete. It is reasonable to expect that existing OPWL pipeline information is similarly deficient For this reason, Section 7.2 4 of the FSP proposes additional data compilation activities focused primarily on better defining the OPWL pipeline network to be completed prior to and concurrent with implementation of the Phase I RFI/RI

It is also acknowledged that because of the age and complexity of the OPWL, there is inherent uncertainty in defining the OPWL based on existing engineering records and employee knowledge This uncertainty affects the scoping and planning of the OU9 investigation The FSP therefore presents a decision process for identifying pipeline sampling locations based on pre-field data compilation results and field observations, rather than identifying specific sampling locations based on available data

2 2 1 General Description

The OPWL is a network of tanks and underground pipelines constructed to transport and temporarily store process wastes from point of origin to on-site treatment and discharge points As currently defined, the system consists of approximately 35,000 feet of pipelines and 39 separate tank locations that house a total of 65 tanks (Figure 2-2) Appendix A provides fifteen detailed OPWL Site Utility Location Maps which show the OPWL components in relation to RFP structures and other site utilities The areas covered by these fifteen maps are keyed to the alphanumeric coordinates shown in Figure 2-2

Components of the OPWL exist in RFP areas 100, 300, 400, 500, 600, 700, 800, and 900, at the RFP Solar Evaporation Ponds, and between the Solar Ponds area and holding Pond B-2 in the Walnut Creek drainage (Figure 2-2) The system was placed into operation in 1952 and additions were made to the system through 1975. The OPWL system was replaced over the 1975-1983 period by an inspectable process waste system. Some tanks and pipelines from the original system were incorporated into the new process waste system or into the RFP exhaust plenum fire deluge system (DOE, 1988).

The OPWL is known to have transported or stored various aqueous process wastes containing low-level radioactive materials, nitrates, caustics and acids Small quantities of other liquids were also handled in the system, including pickling liquor from foundry operations, medical decontamination fluids, miscellaneous laboratory wastes, and laundry effluent. Certain process waste streams also contained metals, Volatile Organic Compounds (VOCs), oils and greases, and cleaning compounds The composition of individual process waste streams handled by the OPWL varied widely, and some OPWL components were not exposed to all potential process waste compounds

The general purpose of the OPWL was to transfer process waste from facilities which generated the wastes to the RFP process waste treatment facility The treatment facility was housed in Building 774 during the years of OPWL operation Since this time, process waste treatment operations have largely been transferred to Building 374 Building 774 now is the primary waste treatment facility for Building 771 process wastes Other OPWL components were used to transfer treated process wastes from Building 774 to disposal locations, including the Solar Evaporation Ponds and holding Pond B-2 It appears from RFP utility drawings that some OPWL pipelines may have transferred treated wastes from Building 774 back to production facilities for recovery of recyclable materials, such as plutonium and americium (EG&G, 1990a) Available information is not sufficient to clearly define the roles of many of the OPWL pipelines and tanks Some of the tanks shown on Figure 2-2 are not connected to the OPWL pipeline network Some tanks, such as T-27 (a portable liquid dumpster located west of Building 886), were mobile and were never permanently connected to the OPWL pipeline network However, it is possible that some ancillary OPWL pipelines were not identified as OPWL components during previous investigations The additional data compilation activities addressed in Section 7.2.4 will attempt to better define OPWL components, OPWL waste flow, flow mechanisms, and points of process waste origin and destination.

Appendix B provides data summary sheets containing detailed information on each of the pipeline sections and tank locations identified in the Closure Plan. The following sections provide a general overview OPWL physical characteristics, operations, and current status

2.2 2 Pipeline Network

As discussed previously, the OPWL pipelines will undergo additional investigation as part of the Phase I RFI/RI to better evaluate their operational history and current status The information presented in this section is based primarily on existing data from the Closure Plan (DOE, 1988). Where possible, the Closure Plan information was corroborated using current RFP utility location maps (EG&G, 1990a)

The OPWL pipeline network consists of 57 designated pipe sections extending between 24 buildings (Table 2 1). The pipeline sections have a total length of approximately 35,000 feet Approximately 13,000 feet of the pipelines are located beneath buildings, and approximately 7,000 feet are beneath concrete or asphalt pavement Roughly 13,000 feet, or more than half of the 22,000 feet not located beneath buildings, are located in areas highly congested with other active and inactive utility lines and structures (DOE, 1988) As illustrated in the OPWL Site Utility Location Maps (Appendix A), these utilities and structures include raw and domestic water, steam, air, sanitary sewer, storm sewer, electric, natural gas, nitrogen, cables, and foundation drains In contrast to data presented in the Closure Plan, direct measurement from RFP utility plans suggests that approximately 18,000 feet of OPWL pipelines are not located beneath buildings (EG&G, 1990a). As discussed in Section 7 1, some OPWL structures located beneath buildings will not be investigated under the Phase I RFI/RI OPWL structures beneath buildings that are partially accessible will be investigated to the extent possible

2.2.2.1 Construction

The OPWL pipelines vary from one inch to ten inches in diameter and are constructed of a variety of materials, including black iron, cast iron, plastic, polyethylene, vitrified clay, cement/asbestos, saran-lined steel, stainless steel, fiberglass, PVC, pyrex glass and teflon The pipelines are buried in trenches averaging three feet wide and three to eight feet deep, and are bedded in sand and/or native soil backfill (DOE, 1988, EG&G, 1990a). Existing information is not sufficiently detailed to determine the exact depth of individual pipelines. Pipeline depths will be determined through excavation of test pits, as described in Section 7.3.1.1

2.2 2 2 Operation

The OPWL was not a continuously flowing system during the period of operation. The system was designed to handle one process waste at a time Prior to transfer of the process waste, an analysis of the waste was made This analysis was forwarded to the process waste treatment facility (Building 774) and a request was made for permission to transfer the waste When permission was obtained, the pipeline was opened to allow the process waste to flow under gravity drainage The volume of process waste was monitored during flow by gauges both at the point of origin and at the treatment location to ensure that the entire shipment was received (DOE, 1988). Available records of pre-shipment analyses will be obtained during the additional data compilation activities (Section 7 2 4) in order to better characterize OPWL waste streams and potential OPWL contaminants It is expected, however, that these analyses focused only on primary or known waste components (especially radionuclides), and that they will provide only a partial accounting of potential contaminants of concern for the OPWL

Not all process waste was transferred to Building 774 for treatment. Some untreated process waste was transferred directly to the Solar Evaporation Ponds and Pond B-2. The extent to which the Solar Evaporation Ponds and Pond B-2 were used for treatment of process waste is unclear. Additional data compilation activities (Section 7 2 4) will attempt to better define the extent to which OPWL waste was treated by Building 774, Solar Evaporation Ponds, and Pond B-2

Examination of RFP utility maps and site topography indicates that some OPWL pipelines would have required lift stations and/or forced (pumped) flow in order to transfer waste to Building 774 The data summary sheets in Appendix B indicate pipeline segments which are believed to have been under forced flow based on RFP utility maps (EG&G, 1990a) Other references refer to pipeline structures, such as cleanouts and manholes, which are not specifically addressed in the Closure Plan. Additional data compilation activities (Section 7.2.4) will attempt to better define OPWL pipeline flow mechanisms and structures It is known from existing information that valve vaults were constructed at a number of pipeline intersections to facilitate access to and maintenance of pipelines and valves These concrete structures typically were built below grade and served as secondary containment in the event of a leak at the pipeline intersection or valve OPWL valve vaults are shown on the OPWL Site Utility Location Maps in Appendix A. Valve vaults will be investigated during the Phase I RFI/RI as discussed in Section 7 3 1 1

2 2 2 3 Current Status

Although the Closure Plan indicates that some OPWL pipelines were converted to the inspectable process waste system, it does not specifically identify these pipelines The 57 pipelines designated in the Closure Plan, and described in Table 2 1 and Appendix B, are identified specifically as OPWL pipelines that were not converted to the new process waste system These lines, designated P-1 through P-57, are no longer used and are believed to have been abandoned in place Pipelines beneath buildings were flushed with water until significant residues appeared to have been removed, then sealed at wall and floor penetrations with six to twelve inch plugs of "non-shrinking cement sealant" (DOE, 1986b) This water was transferred to Building 774 for treatment (DOE, 1986b) Small segments of pipelines within buildings (e g , riser pipes) were removed Underground pipelines outside of buildings were abandoned in place without sealing or decontamination (DOE, 1988)

Portions of some of the pipelines may have been removed during the installation of the new process waste system, or during other RFP construction activities. Disruption of pipeline trench fill materials during subsequent excavations may have changed the distribution of any contaminants around the pipelines Because most of the OPWL is believed to have drained by gravity, no process waste other than a residual coating is anticipated to exist in most of the pipelines, unless areas of differential settlement have created sags in some pipelines Residual waste may also exist in portions of forced-flow pipelines. Additional data compilation activities will attempt to better define the current status of the OPWL pipelines prior to commencing field activities

2.2.3 OPWL Tanks

In September and October 1990, the 39 OPWL tank locations identified in the Closure Plan were further characterized to better evaluate their operating history and current status (DOE, 1991c) The results of this characterization were intended to supplement the Closure Plan information to aid in planning the OU9 RFI/RI. Additional investigation is planned under the additional data compilation activities (Section 7 2.4) to determine whether OPWL tank locations exist which were not identified in the Closure Plan The information presented in this section is based on the results of the 1990 additional data compilation (DOE, 1991c) and on existing data from the Closure Plan (DOE, 1988)

The 39 OPWL tank locations summarized in Table 2 2, designated T-1 through T-39, include all tanks that are known to have been part of the OPWL system Many of the locations contain more than one tank, a total of 65 tanks exist at the 39 designated locations OPWL tanks are located in Areas 100, 400, 500, 700, 800 and 900. The tank locations are shown in Figure 2-2, and in greater detail on the OPWL Site Utility Location Maps in Appendix A Detailed information about each tank location is provided in the OPWL Data Summary Sheets in Appendix B

2 2 3 1 Construction

OPWL tanks of known size range in volume from 250 to 200,000 gallons and are constructed of concrete, steel or stainless steel As shown in Table 2 2, the tanks can be grouped into six types of construction (DOE, 1988, DOE, 1991c)

- Floor Sump (used for incidental spill control)
- Sump (open top or covered)

- Underground (sealed, permanently closed top)
- Above-Grade
- On-Grade

Underground tanks located outside buildings are buried up to twenty-five feet below the ground surface (EG&G, 1990a). Floor sumps typically are located inside buildings on the ground floor or basement level (DOE, 1991c) OPWL tanks outside production buildings often are located inside small concrete structures ("process waste pits") built specifically to house and provide access to the tanks These structures typically are built below grade, and in some instances served as secondary containment in the event of a tank leak or overflow. Tanks inside process waste pits are identified on the OPWL Data Summary Sheets in Appendix B

2 2 3 2 Operation

The OPWL tanks were used for temporary storage of process waste, both at the point of waste origin prior to transfer through the pipelines and at the point of destination prior to waste treatment and/or disposal The tanks typically were allowed to fill over the course of days or weeks to a certain level before being emptied into the pipeline network (DOE, 1988, DOE, 1991c) As mentioned in Section 2 2 2 2, the wastes typically were analyzed for characterization prior to transfer into the pipelines

2 2 3.3 Current Status

Table 2 2 lists the current status of the tanks at each location based on the 1991 tank investigation and on follow-up discussions with RFP personnel The status of the OPWL tanks fall into one of the following categories

- Incorporated into the new process waste system as permitted hazardous and mixed radioactive waste tanks under the RCRA Part B Hazardous and Mixed Waste Operating Permit Application for the RFP (will not be a part of this RFI/RI)
- Incorporated into the new process waste system as 90-day transuranic mixed waste storage tanks under the RCRA Part B Transuranic Mixed Waste Operating Permit Application for the RFP (will not be a part of this RFI/RI)

- Incorporated into the RFP exhaust plenum fire deluge system as emergency temporary holding tanks for potentially contaminated fire water
- In active use but not RCRA-permitted (includes floor sumps and foundation drainage sumps used for incidental spill control which discharge to the new process waste system)
- Physically removed
- Abandoned in place.

Five of the 39 tank locations identified in the Closure Plan were determined through the 1991 investigation to be spurious, that is, these locations have never contained tanks or contain tanks which have never been used for process waste handling and are not associated with the OPWL. The investigation also determined that Tank T-14 was abandoned empty rather than being filled with gravel and capped, as was indicated in the Closure Plan (DOE, 1991c).

A number of the tanks were cleaned and painted prior to being abandoned or incorporated into the plenum deluge system, as identified in the Appendix B data summary sheets (DOE, 1988, DOE, 1991c) According to procedures described in the Closure Plan, the tanks were scrubbed and rinsed repeatedly until a radiation monitoring instrument indicated no change in the radioactivity of the rinsate The tanks were then painted with multiple coats of "Carbonmastic No. 14" paint until a dry film thickness of 0.008 inches was achieved. The paint was intended to serve as an alpha radiation barrier (DOE, 1988)

Since abandonment of the OPWL, the underground concrete sumps located at T-7 and T-8 have periodically filled with ground water The ground water is removed from the tanks and treated in the new process waste system when this occurs (DOE, 1988, DOE, 1991c)

2 2 4 <u>Interactions with Other Operable Units</u>

Because the OPWL network extends throughout much of the RFP main production facility, interactions with other RFP OUs are likely Various components of the OPWL exist within or in close proximity to IHSSs in OUs 1, 4, 6, 8, 10, 12, 13, 14, 15, and 16 (Figure 2-3) Because most of the IHSSs at RFP are still being defined and evaluated, the magnitude of potential interactions are largely speculative Table 2.3 summarizes potential interactions between individual OPWL components and IHSSs in other OUs, based on physical proximity and known histories of some of the IHSSs. The table also summarizes any IAG field investigation requirements for the IHSSs to allow preliminary evaluation of potential overlaps with the OU9 FSP

In addition to these potential interactions, 11 RFP IHSSs target known or suspected OPWL historical release sites (Table 2.4, also identified in Table 2 3). Nine of these IHSSs are within OU8 (700 Area) Per IAG requirements for OU9, the FSP presented in Section 7.0 is scoped to include investigation of these sites as OPWL components

It is clear that detailed coordination of FSPs for the various OUs will be necessary in order to avoid duplication of effort. Tables 2.3 and 2 4 are intended to help focus this coordination. The OU9 FSP presented in this Work Plan, however, does not consider potential interactions with other OUs in selection of sampling locations and analytical parameters

2 3 SITE CONDITIONS

Conditions in the vicinity of OU9 are discussed in this section

2.3 1 Topography

Most of the OU9 is located within the controlled area of the main plant which lies on an alluvial pediment informally referred to as the Rocky Flats mesa (Figure 2-4) The Rocky Flats mesa is a flat alluvial terrace that slopes gently to the east at approximately one degree The pediment and alluvial cover are dissected by several small eastward flowing streams These stream-cut valleys are incised into the bedrock and lie 50 to 200 feet below the pediment surface. Much of the ground surface in the controlled area has been disturbed by earthwork construction, thus obscuring original topographic undulations. Typical existing slopes in the controlled area are approximately two to three percent The pipelines extend to the northern and southern edges of the controlled area, which are at the crests of the mesa where side slopes run down into the drainages of North Walnut and Woman Creeks The eastern portion of the pipelines extends outside of the controlled area to Pond B-2 in the South Walnut Creek drainage, side slopes in this drainage are approximately 15 to 25 percent

2.3.2 Site Geology

Information for the discussion of geology was obtained primarily from the July 1991 draft final Geologic Characterization Report (EG&G, 1991c). Appendix D contains maps showing well and boring locations as of 1990 along with the available logs, installation diagrams, soil and ground water analytical data for borings and wells near OU9 There is an on-going site-wide geological characterization study that includes re-logging of geological core samples and new interpretations regarding the extent of (a) caliche and (b) the Arapahoe Formation sandstones (EG&G, 1990b)

2.3 2.1 Surficial Geology

Surficial deposits in OU9 consist of the Rocky Flats Alluvium, colluvium, valley-fill alluvium, disturbed ground, and artificial fill. These surficial deposits unconformably overlie the bedrock units The main RFP facilities area is located on a terrace (or mesa) which is capped by Rocky Flats Alluvium Colluvium (slope wash) covers the hillsides of the terrace, and valley-fill alluvium is present in the drainages of North and South Walnut and Woman Creeks In addition, there are a few isolated exposures of claystone and sandstone bedrock located along slopes and the road cut directly east of the controlled area Most of the surficial deposits in OU9 consist of disturbed ground overlying the Rocky Flats Alluvium in the main part of the RFP and colluvium in the South Walnut Creek drainage Artificial fill covers the area around Building 881. There is very little undisturbed Rocky Flats Alluvium along the OPWL alignments

The Alluvium Isopach Map, Figure 2-5, produced from a similar figure found in the July 1991 draft final Geologic Characterization Report, was used to estimate total surficial deposit thickness at various locations in OU9 The total thickness of the surficial deposits (equals depth to bedrock) in OU9 can be highly variable over short lateral distances and ranges from less than one foot at the east crest of the mesa to approximately 30 feet at the west end of OU9 near Building 122 Depth to bedrock around the Solar Evaporation Ponds is less than 1 foot to approximately 22 feet, and south of Building 881 at the southern limit of OU9, varies from 4 to 22 feet. North of Building 774 at the northern limit of OU9, depth to bedrock is approximately 10 to 11 feet. Near the center of OU9, depth to bedrock is approximately 10 feet

Rocky Flats Alluvium

The Quaternary Rocky Flats Alluvium is the oldest and topographically highest alluvial deposit at RFP The Rocky Flats Alluvium consists of a series of coalescing alluvial fans deposited by braided streams Rocky Flats Alluvium capped the terrace at RFP prior to plant construction Much of the alluvium on the plant site was removed and/or reworked during construction activities

The Rocky Flats Alluvium is an unconsolidated deposit composed of poorly sorted (well-graded) angular to subrounded cobbles, angular to rounded coarse gravels, coarse sands, and gravelly clays. Generally, it is coarser grained to the west and becomes finer grained towards the east Colors of the Rocky Flats Alluvium include light brown to dark yellowish orange and grayish orange to dark gray. Bedding has been identified only in a gravelly sand in the East Trenches area (EG&G, 1991c). As previously noted, the thickness of the Rocky Flats Alluvium in OU9 ranges from less than 1 foot to approximately 30 feet

The amount of caliche ($CaCO_3$) mineralization in the interstices (pore spaces) of the alluvium ranges from zero to almost 100 percent In areas where caliche has been defined as "abundant" the amount of caliche in the interstices is greater than 25 percent over a one to two foot interval (EG&G, 1991c) It is believed that in OU9, the amount of caliche generally increases as the thickness of the Rocky Flats Alluvium decreases The amount of caliche may have hydrogeologic significance and is discussed further in Section 2 3 3 2

All of the Rocky Flats Alluvium was eroded away in the drainages of North and South Walnut Creeks. Colluvium and valley-fill alluvium were subsequently deposited along the slopes and in the drainage ways.

Colluvium

Colluvial materials (slope wash) are present on hill slopes in the northeast, east and the south-southeast portion of OU9 descending to North and South Walnut Creeks and along the slopes of Woman Creek

Colluvium is described as consisting predominantly of unconsolidated clay with common occurrences of silty clay, sandy clay and gravel layers Color ranges from dark yellowish brown to light olive gray and light olive brown Occasional dark yellowish orange iron-oxide staining and stringers of brownish gray are present Sand, where present, is very fine-grained to coarse-grained and poorly sorted Occasional cobbles occur within gravel layers, which are poorly sorted and unconsolidated.

Valley-Fill Alluvium

The most recent deposit in OU9 is the valley-fill alluvium, which is present in modern stream drainages Within OU9 valley-fill alluvium occurs in the drainages of North and South Walnut Creek It is derived from reworked and redeposited older alluvium and bedrock materials The valley-fill alluvium consists of unconsolidated, poorly sorted sand, gravel, and pebbles in a silty clay matrix. Colors range from olive gray to dark yellowish orange and dark yellowish brown.

Disturbed Ground

Much of the soils in the controlled area of the RFP have been disturbed by building and road construction Disturbed ground is generally described as unconsolidated clay, silt, sand, gravel, and pebbles The materials are very poorly sorted with fragments of claystone and display no bedding Colors range from olive to reddish brown to yellowish gray and gray to yellowish orange Angular to subangular gravels and pebbles of granite and quartzite are commonly found in areas of disturbed Rocky Flats Alluvium or disturbed colluvium Sand, where present, varies from fine-grained to coarse-grained and is very poorly sorted Soil deposits in the area of disturbed ground range in thickness from 0 8 feet at well 32-86 (north of Pond 207-A) to greater than 21 feet at boring SP07-87 (east of Pond 207-B South).

Artificial Fill

There is an area of artificial fill mapped around the 881 building, which was connected to the south portion of OU9 Material excavated for the Building 881 foundation was spread over a large area generally south of the building The very poorly sorted and unconsolidated artificial fill was derived from Rocky Flats Alluvium, colluvium, and fragments of claystone and concrete rubble It is predominantly composed of sandy clay with some gravelly zones. Sand and gravel fill material is expected to have been backfilled in some of the tank and pipe excavations The fill is generally brown to gray in color with occasional zones of moderate yellowish brown staining.

2 3 2 2 Bedrock Geology

The Upper Cretaceous-age Arapahoe Formation unconformably underlies surficial deposits in OU9 The Arapahoe Formation at RFP is composed of approximately 80 percent claystone and silty claystone and approximately 20 percent interbedded, lenticular sandstones. It contains at least five mappable sandstone intervals (EG&G, 1991c) The Arapahoe Formation is approximately 150 feet thick in OU9 and dips gently to the east at about one to two degrees (EG&G, 1991c) Its contact with the overlying surficial deposits generally parallels surface topography As previously stated, depth to bedrock ranges from less than one foot near the extreme eastern limit of OU9 to approximately 30 feet near Building 122 at the west end of OU9

The Arapahoe Formation is a fluvial deposit composed of channel-fill, point bar, and overbank deposits (EG&G, 1991c) Claystones and silty claystones represent overbank deposits, while most of the sandstones in OU9 represent channel-fill and point bar deposition from a meandering stream system flowing generally west to east Contacts between various lithologies are both gradational and sharp Leaf fossils and organic material are found sitewide throughout the Arapahoe Formation in both Arapahoe claystones and sandstones Weathering is observed to penetrate up to approximately 30 to 40 feet into the bedrock

Open and healed fractures have been observed as deep as 220 feet although most that have been described as open are currently believed to be induced during drilling Healed fractures commonly occur in siltstones and very fine-grained sandstones and have less than one millimeter of bedding offset The fractures are generally less than one millimeter wide and are cemented with host rock argillaceous cement and matrix material (EG&G, 1991c).

Arapahoe Claystones/Silty Claystones

The Arapahoe claystones and silty claystones are massive and blocky, containing occasional thin laminae and stringers of sand, silt, and coal Unweathered claystones and silty claystones are light to medium olive gray and occasionally olive black Weathered claystones appear dark yellowish orange and yellowish brown The color difference is the result of iron-oxide staining, which is common at depths from 1 to 20 feet below the base of the surficial material. Leaf fossils and black organic matter occur throughout the claystones

Arapahoe Sandstones

Most of the Arapahoe sandstones are poorly to moderately sorted, subangular to subrounded, silty, clayey, quartzitic, and very fine-grained to medium-grained. The uppermost sandstone (Number One Sandstone) is moderately to well-sorted and very-fine-grained to medium-grained. Some coarse-grained to conglomeratic sandstones have been documented Unweathered sandstones are light gray to olive gray Weathered they appear pale orange, yellowish gray, and dark yellowish orange, as the result of iron-oxide staining. This oxidation is present within 30 to 40 feet of the base of the surficial material. Cementation generally increases with depth as weathering decreases Cementing agents in the sandstones are predominantly argillic with minor amounts of calcium carbonate ($CaCO_3$) and silica Trough and planar cross-stratification are common sedimentary structures (EG&G, 1991c) Individual sandstones have lenticular geometries and contain thin beds or laminae of silt and clay

The Arapahoe Formation contains at least five mappable sandstone intervals The maximum thickness of these sandstone units range from approximately 9 feet to about 27 feet The vertical separation between each unit ranges from 2 to 40 feet (EG&G, 1991c). Leaf fossils and organic material occur throughout the sandstones Sandstones directly subcrop beneath the Solar Evaporation Ponds.

2 3 3 Hydrogeology

Information for the hydrogeology discussion was obtained primarily from the July 1991 draft final Geologic Characterization Report (EG&G, 1991c) This section discusses surface and subsurface hydrogeology specific to OU9

Both ground water recharge and discharge occurs in OU9 Ground water recharge occurs as infiltration of precipitation and surface water seepage from streams, ditches, and ponds Ground water recharge to the subcropping Arapahoe Formation occurs as infiltration of ground water within the surficial material Ground water also discharges in streams, ditches, and seeps along slopes and drainage valleys and becomes surface water Evapotranspiration represents a significant loss to the overall water budget in OU9

2 3 3 1 Surface Water

OU9 lies within the watersheds of three west to east flowing streams North Walnut, South Walnut, and Woman Creeks There are holding ponds in each of the creeks downstream of OU9 (Figure 2-4). In North Walnut Creek, there are four ponds designated A-1, A-2, A-3, and A-4, from west to east. Currently, Ponds A- 1 and A-2 are used only for spill control, and North Walnut Creek stream flow is diverted around them through an underground pipe Previously (until 1980), Ponds A-1 and A-2 were used for storage and evaporation of laundry water. Pond A-3 receives the North Walnut Creek stream flow and runoff from the northern portion of RFP (and OU9) Pond A-4 is designed for surface water control and for additional storage capacity for overflow from Pond A-3 (Rockwell, 1988)

Five retention ponds located along South Walnut Creek are designated B-1, B-2, B-3, B-4, and B-5, from west to east. Currently, Ponds B-1 and B-2 are reserved for spill control, whereas Pond B-3 receives treated effluent from the sanitary sewage treatment plant Ponds B-4 and B-5 receive surface runoff and occasionally collect discharge from Pond B-3. Pond B-5 receives runoff from the central portion of RFP (and OU9) and is used for surface water control in addition to collecting overflow from Pond B-4

The two C-series ponds, C-1 and C-2 (south and east of the plant, respectively), are located along Woman Creek Pond C- 1 receives stream flow from Woman Creek. This flow is diverted around Pond C-2 into the Woman Creek channel downstream. Pond C-2 receives surface runoff from the South Interceptor Ditch along the southern portion of RFP (Rockwell, 1988)

Surface water drainage in OU9 is controlled for the most part by water diversion works such as ditches, pavements, gutters, drains, and culverts Surface water drainage patterns in the controlled area are shown in Figure 1-2 The largest of the runoff control ditches in the controlled area is the Central Avenue Ditch which runs eastward along Central Avenue and discharges to South Walnut Creek (Pond B-5) The other major runoff control ditch is the South Interceptor Ditch which prevents runoff from the south side of the RFP main production area from entering Woman Creek, the ditch discharges to Pond C-2 (Rockwell, 1988)

The discharges from the ponds are monitored to document compliance with NPDES permit requirements In addition to NPDES monitoring requirements, all off-site pond discharges are monitored for concentrations of plutonium, americium, uranium, and tritium (Rockwell, 1988)

2 3 3 2 Ground Water

Available information on ground water in the controlled area where most of OU9 exists is from investigations of the Solar Evaporation Ponds in the northeast portion of the controlled area and the 881 Hillside along the southeast boundary of the controlled area Ground water occurs in both unconfined and confined conditions throughout most of OU9. Figure 2-6 presents a water table contour map for OU9

Unconfined Ground Water

Unconfined ground water occurs in the Rocky Flats Alluvium, colluvium, valley-fill alluvium, disturbed ground, and artificial fill (collectively referred to as the alluvial HSU) Where the Arapahoe sandstones subcrop directly below the surficial material, they are in hydraulic connection, and are collectively referred to as the uppermost HSU

The Arapahoe sandstone geometries are lenticular and laterally discontinuous Although individual sandstones may not be in lateral hydraulic communication, the Number One Sandstone is said to subcrop frequently throughout the RFP area and acts as an unconfined aquifer for a substantial portion of its occurrence (EG&G, 1991c)

Surficial deposits on the Rocky Flats site generally are recharged by infiltration of incident precipitation and by seepage from ponds, ditches and creeks, although the situation in the main plant area probably differs from undeveloped areas because of the greater amount of paved and covered surfaces Large water table fluctuations have been observed in response to seasonal recharge (Hurr, 1976) Alluvial water levels are highest during the spring and early summer months of May and June. Water levels decline during late summer and fall, and some wells go dry at this time of year As a result of water table fluctuations, the extent of saturated surficial deposits fluctuates. Unsaturated surficial deposits exist on the south and east sides of the Solar Evaporation Ponds The shallow ground water system discharges in streams, ditches and at seeps along slopes at the alluvium/bedrock contact

Based on the water table contour map of the RFP site the unconfined ground water in OU9 generally flows easterly, as well as northeast towards North Walnut Creek and southeast towards Woman Creek The main plant area is on a ground water divide which lies approximately west-east beneath Central

Avenue. Consequently, much of the OU9 is upgradient of the Solar Evaporation Ponds and the 881 Hillside.

Generally, the ground water flows along the contact of the surficial material and the underlying Arapahoe Formation claystones in a downgradient direction to the east As previously discussed in Section 1 3 3.8, the alluvial HSU and the uppermost HSU exhibit a highly variable range of hydraulic conductivity values As shown in Table 2 5, hydraulic conductivity values reported by various investigations of the Rocky Flats Alluvium range from 1 x 10^{-2} cm/s (Hurr, 1976) to 4 x 10^{-8} cm/s (DOE, 1988) This wide range of hydraulic conductivity values for the Rocky Flats Alluvium is due to its heterogeneity and vertical and lateral variability. The most recent hydrogeologic investigation suggests the hydraulic conductivity of the Rocky Flats Alluvium and the Arapahoe Number One Sandstone is approximately 6 x 10^{-5} cm/s whereas the claystones have a hydraulic conductivity on the order of 1 x 10^{-7} cm/s (EG&G, 1991c), effectively constraining much of the flow within the alluvial HSU to the surficial material above the surficial material/bedrock unconformity The feasibility of measuring Rocky Flats Alluvium hydraulic conductivity in selected monitor wells at RFP OU1 and OU2 currently is being evaluated Measurement of Rocky Flats Alluvium hydraulic conductivity in wells proximal to the OPWL (listed in Appendix D) is limited to a slug test performed in monitor well 2286 near the Solar Evaporation Ponds This well is screened across the alluvium/bedrock contact, meaning that the value measured, 8 7 x 10^{-6} cm/s, is not necessarily representative of the alluvium alone

Horizontal gradients for the uppermost HSU were calculated from the draft final Geologic Characterization Report (EG&G, 1991c), Upper HSU Water Table Elevation Map and range from approximately 0 02 feet per feet (ft/ft) near the west end of OU9 to about 0.1 ft/ft at the north end of OU9 near Building 774

The depth to ground water is variable and generally becomes shallower as the surficial material thins The depth to ground water at the west end of OU9 near Building 122, is approximately 2 feet and east of the Solar Evaporation Ponds it is approximately 2 to 8 feet The water table depth at the south end of OU9 near Building 881, ranges from less than 1 foot to about 13 feet and at the north end of OU9 near Building 774 is about 13 feet. The information regarding depth to ground water was estimated from the Upper HSU Water Table Elevation Map contained in the draft final Geologic Characterization Report (EG&G, 1991c)

As previously noted in Section 2 3 2.1, the amount of caliche mineralization tends to increase as the thickness of the surficial deposit decreases Furthermore, there are some areas where the amount of caliche in the interstices of the surficial material approaches 100 percent The presence of caliche may prove to be a very useful method of determining localized changes in hydraulic conductivities and ground water flow directions Due to insufficient data on caliche extent in RFP surficial deposits, the extent to which this may be helpful is unknown at this time

Confined Ground Water

Confined ground water in the sandstone units of the Arapahoe Formation occurs throughout most of OU9. Ground water recharge to the Arapahoe Formation occurs as infiltration of alluvial ground water and as infiltration of precipitation where bedrock outcrops in the western portion of the RFP (EG&G, 1991c). The confining layers for the sandstones are the relatively impermeable claystones and silty claystones of the Arapahoe Formation Ground water in the sandstone units of the Arapahoe Formation normally occurs under confined conditions throughout most of RFP. The exception to this is the occurrence of ground water in subcropping sandstone units directly beneath the alluvial HSU

The lower Arapahoe sandstones have a hydraulic conductivity of approximately 10^{-6} cm/s (EG&G, 1991c) An overall downward vertical gradient has been identified but due to lack of data has not been quantified The existence of a vertical gradient is evidenced in the overall decrease in static water levels in monitoring wells with depth (EG&G, 1991c).

The Arapahoe sandstones and the alluvial HSUs have relatively low hydraulic conductivities (Table 2.5), therefore, these units are not generally believed to be capable of producing economical amounts of water.

Generally, both confined and unconfined ground water flow is toward the east Much of the ground water within the uppermost HSU becomes surface water as it leaves the ground water system as seeps along slopes and in stream drainages

Impact of Trench-Fill Structures on the Alluvial Hydrostratigraphic Unit

Industrialization of OU9 significantly affected the hydrogeology of the site Heightened awareness and understanding of the synthetic conditions will facilitate a more accurate site characterization One pivotal construction effect on the alluvial HSU is the creation of alignments of potential preferred migration pathways These potential preferred migration pathways are infilled trenches from buried utilities, such as storm sewers, sanitary sewers, electrical lines, and building foundations, in addition to both abandoned and active process waste pipes and tanks The extent to which these trenches can provide preferred migration pathways is not fully known but must be considered when evaluating OU9 hydrogeology.

2 3 4 Site Access

Access to certain areas of the site may be limited due to physical obstructions or security provisions Much of the OPWL is located in highly congested areas restricted by buildings, overhead lines, underground utilities, etc A limited site accessibility evaluation was performed during the preparation of a preliminary data compilation report (Appendix B) Information relevant to this accessibility evaluation is comprised of field notes taken while conducting tank inspections. These field notes, which are documented on Tank Inspection Forms, contain general information regarding physical obstructions and security restrictions and are included as Appendix E A more detailed assessment of equipment access will be conducted during the site walk to be performed as part of additional data compilation activities (Section 7 2 4 2)

2.4 NATURE OF OPWL CONTAMINATION

A discussion of the nature of potential contaminants in the sources and affected media at OU9 is presented in this section The primary emphasis is placed on characterizing the historical composition of wastes transferred through the OPWL

2 4 1 Waste Characteristics

According to the Closure Plan, RFP process wastes typically consisted of aqueous solutions with elevated nitrates, uranium -233, -234, and -238, and transuranics (plutonium -239 and americium -241) Caustics (bases) and acids also were transported or stored in the system.

Personnel interviews were conducted in September and October 1991, in an effort to better delineate building-specific process waste streams that would have been discharged into the OPWL All buildings that generated process waste and were part of the OPWL network were addressed Interviewees were categorically questioned regarding radionuclides, acids, bases, inorganics (metals), oils, solvents, polychlorinated biphenyls (PCBs), pesticides, herbicides, and other potential constituents such as personnel decontamination fluids The goal was to obtain a more detailed accounting of the original building-specific waste streams than was previously available Information obtained did not constitute a complete, comprehensive inventory of every constituent discharged into the OPWL, but rather an improved general understanding of primary constituents characteristic of each building's process waste stream Currently, the results are considered the most complete listing of waste streams sent through the OPWL and are presented in Table 2 6 A summary of the predominant waste streams identified through the interview process follows

Low-level radioactive aqueous wastes with high nitrate concentrations were a primary OPWL waste stream. Uranium, including the isotopes U-234, U-235, and U 238, was present in the wastes in the OPWL Plutonium, the only transuranic element used in manufacturing at the RFP, is also known to have been present in process wastes RFP plutonium consists primarily of the isotope Pu-239, with a lesser amount of Pu-240, and trace amounts of Pu-238, Pu-241, and Pu-242 (DOE, 1980) Americium-241, a daughter product of Pu-241, has also been found at the RFP site

Because the OPWL handled aqueous process wastes, efforts were made to prevent volatile organic compounds from entering the system and disrupting waste treatment activities. However, per the above described personnel interviews, volatile and semivolatile organics were transferred through the OPWL in small quantities. The organic constituents that most likely were discharged to the OPWL include 1,1,1 -trichloroethane (TCA), trichloroethylene (TCE), carbon tetrachloride, freons, ammonium thiocyanate, acetone, alcohols, xylenes, and toluene.

Numerous acids were used extensively and discharged into the OPWL. The primary acids discharged into the OPWL include nitric, hydrofluoric, perchloric, sulfuric, phosphoric, and chromic acid. The dominant bases discharged into the OPWL include ammonium hydroxide, sodium hydroxide, potassium hydroxide, and calcium hydroxide The primary metals that were transferred through the OPWL in small quantities include titanium, tantalum, lead, beryllium, chromium, nickel, and mercury.

Small quantities of other liquids in the system included medical decontamination fluids, pickling liquor from foundry operations, and miscellaneous laboratory liquids, janitorial waste, and laundry effluents

The 1976 report by Sunday, which is presented in Appendix C, contains information on the process waste volumes and chemistry for specific building areas Citations of chemical information in the Sunday report indicate the OPWL primarily contained the following constituents:

- Uranium 238
- Uranium 235
- Plutonium
- Nitrate
- Acids
- Bases
- Hexavalent chromium

Constituents mentioned less often in the Sunday report were

- Chromium
- Beryllium
- Iron
- Iodine
- Phosphate
- Tritium

Table 7 2 presents the analyte list for Stage 1 sampling activities

2 4 2 <u>Sources/Releases</u>

The OPWL tanks and pipes are the main sources of potential contamination at OU9 Occasional accidental releases of process waste from tanks and pipes have occurred Releases have occurred as a result of

- Leakage of pipe fittings, including joints, elbows, reducers, junction boxes and valve vaults
- Deterioration of tanks and pipes from age
- Breakage of the lines due to construction activities, settling of man-placed soil fill or settling of building foundations
- Overflows due to improper tank filling
- Overflows at junction boxes and valve vaults
- Incompatibility of the process waste with the pipes, gaskets, and tank material

Historical OPWL release data will be used to delineate areas of concern These release locations will be preferentially targeted for field sampling The locations and other pertinent information of reported releases are incorporated into the OPWL Data Summary Sheets in Appendix B

The lateral and vertical extent of the releases are not precisely known but are expected to be largely confined to the pipeline trench backfill materials and adjacent soils. The typical trench is approximately three feet wide and extends to the depth of the pipe. Sand was commonly used to bed the pipe in the bottom of the trench (DOE, 1988)

Quick identification of some releases was made by identifying discrepancies between gauge measurements at the points of origin and destination. In some reported incidents, appearance of liquids at the ground surface also permitted detection (DOE, 1988) A more detailed release volume discussion is presented in Sections 2 5 2.1 and 2 5 2.2 Any additional available documentation regarding calculated release volumes will be obtained during the additional data compilation activities.

Prior to the initiation of field activities, additional data compilation activities, discussed in Section 7 2.4, will be performed to ensure, in part, that all available release information is obtained and effectively utilized The Historical Release Report (HRR) project, an ongoing site-wide investigative study, has assembled a database of available information pertinent to past releases at the RFP. One element of the additional data compilation activity will be to query the database for release information related to the OPWL, which will be used in the design of the OU9 FSP.

Since abandonment of the OPWL, the underground tanks at the southeast corner of Building 559 (Tank T-7) and north of Building 771 (Tank T-8) have periodically filled with ground water (DOE, 1988, West, 1977, and EPA, 1988b) The ground water is removed from the tanks when this occurs and is treated in the new process waste system

2 4 3 Previous OPWL Investigations

Few OPWL-specific investigations have been conducted Information regarding previous OPWL investigations was obtained primarily from the September 1976 Survey of the Status of the Existing Process Waste Lines, by G Sunday (Appendix C, Document C-2) The Sunday report is a compilation of OPWL data pertaining to waste streams, physical information (e g , size, locations, age, construction materials, etc.), and soil sampling results. This information has been incorporated into this Work Plan Table 2 7 includes the soil sampling results presented in the Sunday report

A second study, the August 1971 Pressure Testing and Leak Location Survey of Process Waste Lines at the Rocky Flats Facility, conducted by International Leak Detection Services, Inc , hydrostatically tested approximately 12,000 feet of process waste line and wherever possible pinpointed leak locations The results of this investigation are expected to help in defining probable OPWL release locations to be investigated under the OU9 RFI/RI Although the text portion of the study is provided in Appendix C (Document C-3) and has been incorporated into this Work Plan, essential maps and supporting documentation were not obtained Copies of these materials are believed to be held at the Federal Records Center in Denver, Colorado, and an attempt will be made to obtain these during additional data compilation activities (Section 7.2.4)

The Closure Plan extracted information from the text portion of the study which has been incorporated into this Work Plan Under the additional data compilation activities, this information will be verified and augmented if necessary

2 4 3 1 Previous Soil Sampling

In 1976, several soil samples were obtained at OU9 and chemically analyzed (Appendix C, Document C-2) The samples were obtained from areas of known leaks and repairs along the OPWL The soil samples were tested for levels of nitrate and plutonium, both of which were used extensively in the processes at the plant and are characteristic of the process wastes The locations of the soil samples and the results of the analyses are presented in Table 2 7 All soil samples were obtained from the bit of an auger after drilling to depths of approximately four feet.

Table 2 7 also includes natural background results from the geochemical study of background chemical concentrations for geologic materials, sediments, surface water and ground water for the Rocky Flats Plant (EG&G, 1991d) Comparison with background data for the Rocky Flats Alluvium suggests that some of the 1976 results for nitrate and plutonium were elevated

2.4.3.2 Previous Ground Water Samplıng

Some ındication of probable ground water qualıty for the OPWL area can be obtaıned from the water qualıty data of the upgradıent wells at the Solar Evaporatıon Ponds (OU4) and 881 Hıllsıde (OU1) sıtes At the Solar Evaporatıon Ponds, the upgradıent ground water contaıns (a) chlonnated volatıle organıcs, predominantly carbon tetrachlonde, TCE, and chloroform, wıth concentrations up to several hundred µg/l, and (b) elevated levels of total dıssolved solids (TDS) and nıtrate (EG&G, 1990c) Near Buıldıng 881, alluvıal well 1-87, which is upgradıent of the 881 Hıllsıde IHSSs, has had elevated levels of gross alpha, gross beta, uranıum 233 and 234, uranium 235, and uranıum 238 The OPWL ıs one of the possıble sources for these elevated ground water concentrations

2 5 CONCEPTUAL MODEL

Utılızıng the known sıte physıcal condıtıons and potentıal contaminatıon sources descnbed ın the preceding sectıons, a conceptual model of exposure pathways for OU9 is developed here for use in the evaluatıon of the potentıal nsks of OU9 contamınatıon to human health and the envıronment

The pnmary purpose of the conceptual model ıs to aıd ın ıdentıfyıng exposure pathways by whıch human and bıotıc receptors may be exposed to contamınants The EPA defines an exposure pathway as " . a unique mechanısm by whıch a populatıon may be exposed to chemıcals at or ongınatıng from the sıte " (EPA, 1989b) As shown ın Fıgure 2-7, an exposure pathway must ınclude a contamınant source, a release mechanısm, a transport medıum, an exposure route, and a receptor An exposure pathway ıs not complete wıthout each of these five components The ındividual components of the exposure pathway are defined as follows

- Contamınant Source (Section 2.5 1) For purposes of the OU9 conceptual model, the contamınant source ıs dıvıded ınto hıstoncal sources (OPWL pıpelıne and tank releases) and current sources (soıls whıch potentıally have been dırectly affected by these releases) Because the OPWL may feasıbly contaın wastes whıch can stıll be released to the envıronment, pıpelıne and tank releases are also shown as a current contamınant source

- Release Mechanısm (Sectıon 2 5 2). Release mechanısms are physıcal and/or chemical processes by whıch contamınants are released from the source The conceptual model ıdentıfies hıstoncal mechanısms whıch released contamınants directly from the historical sources (in this case, leaks, spills and overflows), mechanisms which release contaminants directly from the current contaminant sources (primary release mechanisms), and those which release contaminants from transport media (secondary release mechanisms)

- Transport Medium (Section 2.5 2): Transport media are the environmental media into which contaminants are released from the source and from which contaminants are in turn released to a receptor (or to another transport medium by a secondary release mechanism) Potential transport media for OU9 include air, surface water, ground water, and biota

- Exposure Route (Section 2 5 3)· Exposure routes are avenues through which contaminants are physiologically incorporated by a receptor Exposure routes for receptors at OU9 are inhalation, ingestion and dermal contact

- Receptor (Section 2 5.3). Receptors are human or environmental populations which are affected by the contamination released from a site Human receptors for OU9 include RFP workers and visitors Environmental receptors include biota (both flora and fauna) indigenous to the OU9 environs.

The conceptual model provides a contaminant source characterization and an overview of all the potential exposure pathways that may result from releases from and into each transport medium (Section 2.5 4) Some of these pathways have a higher potential for occurrence than others Significant exposure pathways are identified by evaluating the fate and mobility of the contaminant in each potential source and transport medium

2 5.1 Contaminant Source

As shown in Figures 2-8 and 2-9, the primary contaminant source at OU9 is considered to be the OPWL pipelines and tanks These OPWL components transported and stored aqueous process waste containing numerous compounds, and constitute both an historical and a current contaminant source In addition, soils contaminated by OPWL releases are considered a current contaminant source

2 5 1.1 Source Characteristics

The OPWL is described in detail in Section 2 2 The OPWL consists of approximately 35,000 feet of pipelines and 65 tanks located throughout the RFP main production facility (Figure 2-2) These components were used to store and transport aqueous process waste at the RFP between approximately 1951 and 1980 The pipeline network is believed to be buried to depths ranging from three to eight feet in trenches approximately two to three feet wide. The bottoms of some underground tanks may be twenty feet or more below the ground surface Some of the underground tanks are known to penetrate the water table in the upper hydrostratigraphic unit, and it is possible that soils surrounding some pipelines are saturated, particularly during spring months when the water table typically is highest. It is believed that some of the pipelines and underground tanks are bedded in native soil backfill, while others are bedded in sand or gravel. Few of the tanks and very few of the pipelines are known to be doubly contained Although much of the OPWL reportedly was flushed, drained and/or cleaned and painted when taken out of service, it is likely that residual contamination exists in some pipelines and tanks which potentially constitute a current contaminant source

As discussed in Section 2 4.2, historical OPWL releases to the ground surface and beneath the surface are known to have occurred Soils impacted by these releases therefore constitute a current contaminant source

2 5 1 2 Contaminant Characteristics

Characteristics of RFP process waste are addressed in Section 2 4 The various OPWL components handled different process waste streams, and the composition of these waste streams varied widely Table 2 6 characterizes process waste streams for different RFP production and support buildings, and the OPWL Data Summary Sheets in Appendix B show the inferred waste streams handled by specific pipelines and tanks. Available analytical results from environmental media potentially contaminated by the OPWL are provided in Appendix D Section 7 2 2 provides the rationale for selecting contaminants of concern for the OU9 Field Sampling Plan

2 5 2 Release Mechanisms and Transport Media

The primary release mechanism for OU9 is leaks, spills, and overflows of process waste from the OPWL tanks and pipelines Historical accounts of OPWL releases (Section 2 4 2) indicate that the releases could potentially have impacted the transport media of air, surface water, ground water, and biota through the pathways illustrated in Figures 2-8 and 2-9.

2.5.2.1 Pipeline Releases

Pipeline releases, and contamination along the OPWL pipelines, are most likely to occur at the following locations.

- Valves, cleanouts and other pipeline openings
- Intersections between pipeline segments, especially where size reductions and changes in pipeline material occur
- Elbows and joints
- Pipe/tank connections
- Areas of pipeline corrosion
- Sections of pipeline broken during settling or excavation

OPWL pipelines are believed to be bedded either in sand or in native soil backfill. Hydraulic conductivity in clean sand can be expected to range from 10^{-3} to 1 cm/s (Freeze and Cherry, 1979). In contrast, measured hydraulic conductivity in the Rocky Flats Alluvium, the deposit in which the great majority of OPWL pipelines are located, ranges from 10^{-2} to 4 x 10^{-8} cm/s (Table 2.5, see discussion in Section 1.3.3.8). The hydraulic conductivity of unconsolidated deposits such as the Rocky Flats Alluvium can be expected to increase when deposit is disturbed (e.g., excavated and replaced as backfill material) due to increased porosity in the disturbed material (McCarthy, 1982). It is therefore considered very likely that most pipeline releases initially flowed preferentially through the trench materials, and permeated the surrounding native soils to a much lesser extent than the trench materials. Over time, the released materials may gradually have infiltrated surrounding native soil, particularly the soil beneath the trench. Any contaminant plumes from pipeline releases are expected to be strongly aligned along pipeline trenches, and perhaps to extend below the trenches into the underlying soils. Ground water which may periodically or perennially saturate pipe trenches can also be expected to flow preferentially through the trench materials, and any resulting spread of contamination should remain strongly oriented along the trench (this is not to say that ground water may not gradually spread the contamination outside the trench, but is to say that the contaminant plume will remain preferentially aligned).

Contaminant plumes resulting from slow, gradual pipeline leaks may be less strongly oriented along pipeline trenches than those from releases with higher flow rates. Although release rates for OPWL pipeline leaks sometimes have been estimated in past reports and studies, these estimates most likely reflect only major or catastrophic leaks It is probable that many leaks occurred from the pipelines which were never detected due to low flow rate (as well as remote location, depth of burial, or overlying pavement or structures). It is also probable that some major or catastrophic releases were preceded at the same location by a longer period of slow leakage as the pipeline gradually failed However, it is still considered likely that the relatively much higher hydraulic conductivity of the trench materials will control the orientation of contaminant plumes from gradual pipeline leaks, albeit to a lesser degree than those from more sudden releases

Historical release documents record estimated pipeline release volumes up to several thousand gallons As mentioned previously, these estimates most likely reflect major or catastrophic leaks For purposes of a conceptual pipeline release model, 500 gallons is considered a reasonable approximation of average release volume when slower, more gradual releases are taken into account. Using trench fill properties of 115 pounds per cubic foot dry density, 35 percent porosity and ten percent moisture content by weight of dry soil, and assuming a saturated cross sectional area 3 0 feet wide by 0 5 feet deep (DOE, 1988) with negligible infiltration into surrounding soil, the hypothetical contaminant plume would extend approximately 300 feet along the trench This calculation is presented in Table 2 8

As discussed above, some infiltration into native soil surrounding the trench undoubtedly occurred from pipeline releases, especially gradual releases Such infiltration would act to decrease the length of the contaminant plume along the trench Because this infiltration is not expected to be appreciable, a dividing factor of 1 5 in the estimate of average contaminant plume length provides a safe and reasonable margın of compensatıon for ınfiltration ınto natıve soıl Therefore, 200 feet is the proposed maxımum spacıng for soıl samplıng (ı.e , test pit locatıons) along the OPWL pıpeline alıgnments

It ıs acknowledged that 200 foot test pıt spacıng may not detect all release locations along the OPWL pıpelines, partıcularly low-volume, intermıttent releases. Although pressure testing of lınes between test pıts may aıd ın ıdentıfyıng release locatıons that are not physıcally excavated, no approach short of complete excavatıon and composıte samplıng can ensure that all pıpeline release locatıons are ıdentıfied The FSP (Sectıon 7 0) ıs desıgned to provıde a reasonable and dilıgent effort toward locatıng those pıpelıne releases whıch are more lıkely to constıtute a potentıal threat to human health or the envıronment It should be noted that, for most pıpelıne sectıons, test pıts will target structural features (e g , elbows, tees, and valves) and/or known hıstorıcal release locatıons The 200 foot maxımum test pıt spacing is a contingency ın the absence of specific target areas along the pıpelines, and wıll most lıkely be employed only on a few long sectıons of pıpelıne Although the preceding conceptual model suggests lımıted contamınant ınfiltratıon ınto natıve soıls, the FSP does not elımınate natıve soıls around pıpelıne trenches from ınvestıgatıon The need to ınvestıgate these soils wıll be addressed ın technıcal memoranda on a sıte-specıfic basıs ın those areas where sıgnıficant contamınatıon ıs detected ın trench fill materıals (Sectıon 7 3 1 3)

2 5 2 2 Tank Releases

Tanks releases are most lıkely to occur at the followıng locatıons

- Tank openıngs (e g , overflows)
- Tank/pıpe connectıons
- The base of the tank where resıdual waste collects, and where underground tanks may be ın contact wıth ground water
- Cold joınts along the walls of concrete tanks
- Structural seams whıch could be affected by dıfferentıal settlement of the tank beddıng or supports.

Releases from such locations would likely affect the environment immediately surrounding the tank, particularly where the release is from an underground tank bedded in backfill. Based on these conceptual tank release locations, contamination will most likely exist.

- Beneath or near external connections and openings
- Near joints or corners around underground tanks
- Beneath the base of the tank

Tank sampling proposed in the FSP (Section 7 0) targets these locations

2 5 3 Exposure Routes and Receptors

As illustrated in Figures 2-8 and 2-9, contaminants released from OU9 can affect potential receptors through inhalation of airborne particles or vapors, and through ingestion of or dermal contact with contaminated source or transport media Potential human receptors include RFP workers and visitors to the site Environmental receptors include biota (both flora and fauna) indigenous to the OU9 environs, as discussed in Section 1 3 3 5 Because of the location of the OPWL and the nature of the known releases from it, it is reasonable to conclude that contamination from OU9 will not affect off-site populations before characterization and any necessary remediation are performed under the IAG

2 5.4 Exposure Pathway Summary

One of the primary goals of the OU9 RFI/RI is to gather data to support a Baseline Risk Assessment which evaluates the potential risks of OU9 contamination to human health and the environment The OU9 conceptual model developed in the preceding sections identifies potential completed exposure pathways resulting from OU9 releases The pathways listed below are derived from the completed exposure pathways illustrated in the conceptual model flow chart (Figure 2-8) However, the pathway analyses stop at transport media consistent with the scope of the Phase I investigation The analyses describe how each of the listed pathways will be evaluated under the phased RFI/RI approach required under the IAG

- **Release → Soils → Ingestion or Dermal Contact·** Soils affected by OPWL releases may directly affect receptors through ingestion or dermal contact Potential direct impacts of contaminated soil on receptors will be identified and evaluated quantitatively using data collected for OU9 soils during the Phase I RFI/RI.

- **Release → Soils → Volatilization/Evaporation → Air** and **Release → Soils → Wind Erosion → Air.** Soils affected by OPWL releases may serve as a source of contamination to air through volatilization/evaporation of contaminants or wind erosion of contaminated soils. Affected air can impact receptors through mechanisms illustrated in Figures 2-8 and 2-9. Potential impacts of releases from contaminated soil to air will be identified and evaluated quantitatively using data collected for OU9 soils during the Phase I RFI/RI (see Section 8.3 5)

- **Release → Soils → Surface Runoff/Erosion → Surface Water/Sediments.** Soils affected by OPWL releases may serve as a source of contamination to surface water/sediments through erosion or leaching into surface runoff Affected surface water/sediments can impact receptors through mechanisms illustrated in Figures 2-8 and 2-9 Potential impacts of releases from contaminated soil to surface water/sediments will be identified using data collected for OU9 soils during the Phase I RFI/RI These impacts will be evaluated quantitatively, if necessary, through surface water and/or sediment sampling and characterization during the Phase II RFI/RI

- **Release → Soils → Infiltration/Percolation → Groundwater** and **Release → Soils → Leaching → Groundwater.** Soils affected by OPWL releases may serve as a source of contamination to groundwater through infiltration/percolation of released liquids and through leaching and remobilization of contaminants to the water table by infiltrating groundwater. Affected groundwater can impact receptors through mechanisms illustrated in Figures 2-8 and 2-9 Potential impacts of releases from contaminated soil to groundwater will be identified using data collected for OU9 soils during the Phase I RFI/RI These impacts will be evaluated quantitatively, if necessary, through groundwater sampling and characterization during the Phase II RFI/RI

- **Release → Soils → Bioconcentration/Bioaccumulation → Biota** and **Release → Soils → Tracking → Biota** Soils affected by OPWL releases may serve as a source of contamination to biota through direct biotic uptake from the soil (bioconcentration/bioaccumulation) and through physical contact (tracking) Affected biota can impact receptors through mechanisms illustrated in Figures 2-8 and 2-9 Potential impacts of releases from contaminated soil to biota will be identified using data collected for OU9 soils during the Phase I RFI/RI These impacts will be evaluated quantitatively, if necessary, through biota sampling and characterization during the Phase II RFI/RI

TABLE 2.1

OPWL PIPELINES

PIPE	BLDG OR AREA	CONFIGURATION[1]	TOTAL LENGTH	OUTDOOR LENGTH[2]	YEAR INSTLD.	DATE ABANDONED
P-1	123	3" Poly in 4" Stl	180 ft[a]	120 ft[a]	1968	June 1982
P-2	123	4" CI	452 ft[b]	0[b]	1952	June 1982
P-3	441	4" VC	162 ft[b]	158 ft[a]	1952	June 1982
P-4	400, 600, 800 Areas	4" CI	1773 ft[a]	1773 ft[a]	1952	April 1982
P-5	444	4" CI	1561 ft[b]	152 ft[a]	1952	April 1981
P-6	881	3" Stl	1300 ft[b]	705 ft[a]	1957	December 1980
P-7	881	4" SS	440 ft[b]	85 ft[a]	1952	December 1980
P-8	881	2" SS	135 ft[b]	105 ft[a]	1952	December 1980
P-9	883	3" Stl	504 ft[b]	410 ft[a]	1957	March 1984
P-10	865/889	3" SS	1190 ft[b]	455 ft[a]	1968	May 1982
P-11	700, 800 Areas	3" FI in 10" VC	175 ft[a]	175 ft[a]	1952 (10") 1975 (3")	March 1984
P-12	700 Area	3" SaSt in 10" VC	510 ft[a]	510 ft[a]	1952	March 1984
P-13	700 Area	3" FI in 4" FI	500 ft[a]	500 ft[a]	1975	March 1984
P-14	700 Area	3" SaSt in 10" VC	648 ft[a]	648 ft[a]	1952	1968
P-15	700 Area	3" SaSt in 10" VC	785 ft[a]	785 ft[a]	1968	March 1984
P-16	500, 700 Areas	3" PVC	170 ft[b]	110 ft[a]	1968	July 1982
P-17	559	4" Pyrex Glass	1130 ft[b]	135 ft[a]	1968	July 1982
P-18	559	2 75" Tef	150 ft[b]	17 ft(?)[a]	1968	July 1982
P-19	707	3" SS	603 ft[b]	147 ft[a]	1968	March 1984
P-20	700 Area	3" SS	499 ft[b]	475 ft[a]	1968	March 1984
P-21	774	3" SS	386 ft[b]	310 ft[a]	1952	March 1984
P-22	771	6" CI	1205 ft[b]	83 ft[a]	1966	May 1982
P-23	771	10" FI	410 ft[a]	410 ft[a]	1969	May 1982
P-24	771	6 CI	306 ft[b]	295 ft[a]	1966	May 1982
P-25	700 Area	3" CI and Stl	562 ft[b]	495 ft[a]	1972	May 1982
P-26	700 Area	2 - 1 5" PVC	2750 ft[b]	1400 ft[a]	1972	Late 1970s
P-27	774	2 - 3" SS	185 ft ea[b]	124 ft ea[a]	1968	Active(?)

TABLE 2.1

OPWL PIPELINES
(Continued)

PIPE	BLDG OR AREA	CONFIGURATION[1]	TOTAL LENGTH	OUTDOOR LENGTH[2]	YEAR INSTLD	DATE ABANDONED
P-28	700 Area	2 - 3" SS	128 ft ea[a]	128 ft ea[a]	1972	Active(?)
P-29	700 Area	4" SS	197 ft[b]	130 ft[a]	1952	Active(?)
P-30	777	4" Stl	667 ft[b]	70 ft[a]	1957	October 1982
P-31	771, 774	1" Stl	167 ft[b]	170 ft[a]	1952	1972
P-32	776	6" Stl	907 ft[b]	115 ft[a]	1957	December 1982
P-33	700 Area	3" Stl	140 ft[a]	140 ft[a]	1966	1972
P-34	700 Area	3" Stl	198 ft[a]	198 ft[a]	1952	March 1984
P-35	700 Area	2 - 3" Stl	142 ft[a]	142 ft[a]	1952	Active(?)
P-36	700, 900 Areas	3" PVC and SS	599 ft[b]	513 ft[a]	1965	December 1982
P-37	700, 900 Areas	3" Stl, PVC and VC	1449 ft[b]	1350 ft[a]	1957	December 1982
P-38	700, 900 Areas	10" PVC and VC	800 ft[b]	688 ft[a]	1952	December 1982
P-39	900 Area	6" VC	1817 ft[b]	1755 ft[a]	1957	December 1982
P-40	900 Area	6" FI	232 ft[a]	232 ft[a]	1972	December 1982
P-41	700 Area	3" VC	1537 ft[b]	485 ft[a]	1957	December 1982
P-42	700 Area	3" SS	213 ft[b]	188 ft[a]	1957	December 1982
P-43	700 Area	3" Stl	100 ft[a]	100 ft[a]	1952	December 1982
P-44	700 Area	3" Stl	135 ft[a]	135 ft[a]	1952	December 1982
P-45	700 Area	6" VC	130 ft[a]	130 ft[a]	Unknown	Active(?)
P-46	700 Area	3" Stl	142 ft[a]	142 ft[a]	Unknown	Unknown
P-47	700 Area	3" CA	135 ft[a]	135 ft[a]	Unknown	Active(?)
P-48	700 Area	Unknown	193 ft[b]	65 ft[a]	Unknown	Unknown
P-49	700, 900 Areas	8" CI	85 ft[a]	85 ft[a]	Unknown	Unknown
P-50	900 Area	8" CI	105 ft[b]	55 ft[a]	Unknown	Unknown
P-51	778	4" and 6" BI	170 ft[b]	0[b]	1957	1978
P-52	443	4" (unk material)	280 ft[b]	0[b]	Unknown	Unknown

TABLE 2.1

OPWL PIPELINES
(Continued)

PIPE	BLDG OR AREA	CONFIGURATION[1]	TOTAL LENGTH	OUTDOOR LENGTH[2]	YEAR INSTLD	DATE ABANDONED
P-53	881	2" SS	78 ft[b]	65 ft[a]	1952	Unknown
P-54	881	3" SS	138 ft[a]	138 ft[a]	1952	Unknown
P-55	881	4" or 6" SS	158 ft[b]	75 ft[a]	1952	Unknown
P-56	771, 774	3 - 1" Plas 2 - 2" Plas	170 ft[a]	170 ft[a]	Unknown	Unknown
P-57	122	4" CI	112 ft[a]	112 ft[a]	1952	Unknown

1 Pipe Construction Materials

FI	Fiberglass
PVC	Polyvinyl Chloride
CA	Cement-Asbestos
SaSt	Saran-lined Steel
CI	Cast Iron
SS	Stainless Steel
BI	Black Iron
Stl	Steel
Plas	Plastic
Tef	Teflon
Poly	Polyethylene
VC	Vitrified Clay

2 Outdoor length indicates the total pipe length exclusive of portions beneath building foundations

a Pipe length measured from Site Utility Location Maps
b Pipe length given in 1988 OPWL Closure Plan (DOE, 1988)

TABLE 2.2

OPWL TANKS

TANK	BLDG [1]	NO TANKS	CONST TYPE[2]	CONST MATL [3]	VOL (gal)	YEAR INST	STATUS[4]
T-1	122	1	UG	SS	800	1955	Removed (Jan 1984)
T-2	441	1	UG	Conc	3,000	1952	Abandoned (June 1982)
T-3	441 (429)	2	1 - UG 1 - AG1	UG-Conc AG-Stl	UG-3,000 AG-3,200	1952	Abandoned (June 1982)
T-4	447	3	FS	Conc	60 ea	1962	Active[a]
T-5	444	2	AG1	Stl	4,000 ea	1952	Active[b]
T-6	444	2	FS	Conc	500 & 300	1952	Active[a]
T-7	559 (528)	2	AG2	Stl	2,000 ea	1969	Active[c]
T-8	771 (728)	2	UG	Conc	25,000 ea	1952	Plenum deluge[d]
T-9	776 (730)	2	UG	Conc	22,500 ea	1955	Plenum deluge[d]
T-10	776 (730)	2	UG	Conc	4,500 ea	1955	Abandoned (Dec 1982)
T-11	707 (731)	2	SU	Conc	2,000 ea	1959	Active[e]
T-12	N/A	N/A	N/A	N/A	N/A	N/A	Invalid tank location
T-13	774	1	SU	Conc	600	1952	Abandoned (1972)
T-14	774	1	UG	Conc	30,000	1952	Abandoned (Nov 1989)
T-15	774	2	UG	Conc	7,500 ea	1969	Removed (1972)
T-16	774	2	UG	Conc	14,000 ea	1952	Abandoned (Nov 1989)
T-17	774	4	UG	Conc	2-3,750 2-7,500	1969	Removed (1972)
T-18	778	1	SU	Conc	Unknown	Unk	Abandoned (1982?)
T-19	779	2	SU	Conc	1,000 ea	1964	Plenum deluge[d]
T-20	779	2	SU	Conc	8,000 ea	1964	Abandoned (Dec 1982)
T-21	886 (828)	1	FS	Conc	250	1963	Abandoned (1978)
T-22	886 (828)	2	AG2	SS	250 ea	1963	Abandoned (1978)
T-23	865	1	SU	Conc	6,000	1979	Abandoned (May 1982)
T-24	881 (887)	7	AG2	Stl	2,700 ea	1952	Active[b]
T-25	883	2	AG1	Stl	750 ea	1952	Active[b]
T-26	883	3	AG1	Stl	750 ea	1965	Active[b]
T-27	881	1	AG1	Stl	500	Unk	Removed (July 1989)

TABLE 2.2

OPWL TANKS
(Continued)

TANK	BLDG [1]	NO TANKS	CONST TYPE [2]	CONST MATL [3]	VOL. (gal)	YEAR INST	STATUS [4]
T-28	889	2	FS	Conc	1,000	1965	Active[a]
T-29	774 (207)	1	OG	Stl	200,000	1952	Abandoned (1987)
T-30	707 (731)	1	SU	Conc	23,111	1959	Active[e]
T-31	N/A	N/A	N/A	N/A	N/A	N/A	Invalid tank location
T-32	881 (887)	1	SU	Conc	131,160	1952	Active[e]
T-33	N/A	N/A	N/A	N/A	N/A	N/A	Invalid tank location
T-34	N/A	N/A	N/A	N/A	N/A	N/A	Invalid tank location
T-35	N/A	N/A	N/A	N/A	N/A	N/A	Invalid tank location
T-36	771C	1	SU	Stl	500	1965	Abandoned (1984)
T-37	771C	1	SU	Conc	500	Unk	Abandoned (1984?)
T-38	779	1	AG2	Stl	1,000	Unk	Active[c]
T-39	881	4	AG1	Stl	250 ea	1952	Removed (1975)

1 Building numbers in parentheses are process waste pits adjacent to production buildings

2 <u>Tank types</u>

FS	Floor Sump (used for spill control)
SU	Sump (open-top or covered)
UG	Underground (sealed, permanently closed top)
AG1	Above-Grade
AG2	Above-Grade in sump
OG	On-Grade

3 <u>Tank materials</u>

SS	Stainless Steel
Stl	Steel
Conc	Concrete

TABLE 2.2

OPWL TANKS
(Continued)

4 <u>Active tank categories (as marked)</u>

a Incidental spill control, not RCRA-permitted
b RCRA-permitted process waste tank
c 90-day transuranic waste tank
d Converted to the RFP plenum fire deluge system as a firewater catch tank
e Secondary containment for RCRA-permitted waste tank

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS

PIPE	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
P-1	E2	P-1 is partially within IHSS 148 (Waste Spills), OU13 148 targets nitrate and radionuclide contamination around Building 123, including possible leaks from P-1[a, b]. The IAG[3] specifies a surface radiation survey and analysis of soil boring samples for various radionuclides at 148.
P-2	E2	Beneath Building 123; see P-1 comments
P-3	E2	West end is within IHSS 148, see P-1 comments
P-4	E2-E5	West end terminates at OPWL tank location T-3, which is also IHSS 122 (Underground Concrete Tank), OU13 122 targets suspected leaks from T-3[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, various radionuclides and nitrate at 122 This Work Plan proposes that IHSS 122 be incorporated into OU9 Fuel oil from IHSS 129 (Oil Leak), OU10, possibly affects P-4 near its intersection with pipe P-5 north of Building 444 A 120 ft section immediately west of 7th St (including the known P-4 leak area north of Building 663) is overlain by IHSS 117 3 (Chemical Storage, South Site), OU13 117 3 was used for storage of pallets, cargo containers, new drums, and possibly nonradioactive chemicals[a, b]. The IAG specifies a soil gas survey of 117 3, with soil borings and alluvial monitoring wells where the survey detects contamination A 50 ft section beneath 8th St is overlain by IHSS 162 (Radioactive Site #2 - 700 Area), OU14 162 targets several radioactive hotspots detected in 1974 in the pavement of 8th St[a, b] The IAG requires that these hotspots be located, presumably by a surface radiation survey
P-5	E3, F3	South end of outdoor section is within IHSS 157 2 (Radioactive Site - South Area), OU12 157 2 targets suspected uranium and beryllium contamination around Building 444[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, various radionuclides and beryllium at 157 2
P-6	E5, F5	A 100 ft section NW of Building 881 is within IHSS 164 1 (Radioactive Site #2 - 800 Area, Concrete Slab), OU14. 164 1 targets suspected radioactive contamination from a concrete slab which was demolished and removed from the site in 1958[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, HSL semi-volatiles and various radionuclides at 164 1

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS (Continued)

PIPE	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
P-7	F5	Outdoor section south of Building 881 is possibly within IHSS 177 (Building 885 Drum Storage Area), OU15, and may also be affected by hydrocarbon contamination from IHSS 107 (Hillside Oil Leak), OU1. Numerous monitoring wells and boreholes have been completed downgradient of P-7 in conjunction with the 881 Hillside RI.
P-8	F5	P-8 parallels and is immediately adjacent to P-7, see P-7 comments
P-9	E5	None
P-10	E5	None
P-11	D5, E5	North end terminates at IHSS 147.1 (Process Waste Leaks - Maas Area), OU12 147 1 targets suspected process waste line leaks, possibly including leaks from P-11[a, b] The IAG specifies analysis of soil boring samples for HSL volatiles, nitrate, and various radionuclides and metals at 147 1 This Work Plan proposes that IHSS 147 1 be incorporated into OU9.
P-12	D5	South half is within IHSS 147 1 (Process Waste Leaks - Maas Area), OU12 147 1 targets suspected process waste line leaks from P-12 and/or P-13[a, b] The IAG specifies soil borings along the pipe alignment drilled on 20 ft centers to a depth 5 ft below the pipe invert. Soil samples from the borings are to be analyzed for HSL volatiles, nitrate, and various radionuclides and metals This Work Plan proposes that IHSS 147 1 be incorporated into OU9 North end terminates at IHSS 123 2 (Original Valve Vault 7 Location), OU8, a site of known historical process waste leaks[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, various radionuclides, beryllium, nitrate and fluoride at 123 2 This Work Plan proposes that IHSS 123 2 be incorporated into OU9 North end is also within IHSS 150 5 (Radioactive Liquid Leaks West of Building 707), OU8 150 5 targets suspected process waste leaks from pipelines beneath the area[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides, metals and inorganic compounds at 150 5
P-13	D5	P-13 parallels and is immediately adjacent to P-12, see P-12 comments
P-14	C5	Southwest end is within IHSS 150 5 and terminates in IHSS 123 2, see P-12 comments

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS (Continued)

PIPE	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
P-15	C5	South end is within IHSS 150 5 and terminates in IHSS 123 2; see P-12 comments. East-west section between Buildings 707 and 778 possibly is affected by IHSS 118 2 (Multiple Solvent Spills), OU8. 118.2 targets suspected releases from an aboveground carbon tetrachloride tank on the north side of Building 707[a, b]. The IAG specifies a soil gas survey and analysis of soil boring samples for HSL volatiles and various radionuclides at 118.2
P-16	C4, C5	A 50 ft section beneath 8th St is within IHSS 162 (Radioactive Site #2 - 700 Area), OU14 162 targets several radioactive hotspots detected in 1974 in the pavement of 8th St[a b] The IAG requires that these hotspots be located, presumably by a surface radiation survey
P-17	C4	IHSS 159 (Radioactive Site - Building 559), OU8, targets historical leaks from the section of P-17 immediately east of Building 559[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides and metals at 159. This Work Plan proposes that IHSS 159 be incorporated into OU9
P-18	C4	IHSS 197 (Scrap Metal Sites), OU16, is just west of P-18, but is not expected to be a significant source of contamination[a]
P-19	C5, D5	None
P-20	B5, C5	None

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS
(Continued)

PIPE	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
P-21	B5	North end is within IHSS 150.3 (Radioactive Liquid Leaks Between Buildings 771 and 774), OU8 150 3 targets suspected leaks from various OPWL pipes and tanks[a, b], possibly including P-21. The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides, metals and inorganic compounds at 150.3 P-21 terminates at OPWL tank locations T-15 and T-17, which are also IHSS 146 (Concrete Process Waste Tanks), OU8 The six tanks at this site were removed in 1970 Numerous process waste releases reportedly occurred from the tanks while they were in service[a, b]. The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, HSL semi-volatiles, and various radionuclides, metals and inorganic compounds at 146 This work Plan proposes that IHSS 146 be incorporated into OU9 South end is within IHSS 137 (Cooling Tower Blowdown, Building 774), OU8 137 targets suspected cooling tower blowdown water spills, which may have contained chromate[a, b] The IAG specifies analysis of soil boring samples for total chromium at 137
P-22	B5	Most of P-22 is within IHSS 150 1 (Radioactive Liquid Leaks North of Building 771), OU8 150 1 targets process waste leaks and numerous other historical releases immediately north of Building 771[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides, metals and inorganic compounds at 150 1 P-22 terminates at OPWL tank location T-8, which is also IHSS 126 (Out-of-Service Process Waste Tanks), OU8 126 targets suspected leaks from the two process waste tanks at T-8[a, b] The IAG specifies analysis of soil boring samples for HSL volatiles, various radionuclides, beryllium and nitrate at 126 An alluvial ground water monitoring well north of IHSS 126 is also specified This Work Plan proposes that IHSS 126 be incorporated into OU9
P-23	B4, B5	Section north of Building 771 is within IHSS 150 1 and terminates at IHSS 126, see P-22 comments South end of the section west of Building 771 is within IHSS 150 2 (Radioactive Liquid Leaks West of Building 771), OU8 150 2 targets releases from past fires in Buildings 771 and 776, including a 1957 fire which radioactively contaminated the area southwest of Building 771[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides, metals and inorganic compounds at 150 2

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS (Continued)

PIPE	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
P-24	B5	P-24 is within IHSS 150.1 and terminates at IHSS 126; see P-22 comments
P-25	B5	Section of P-25 is within IHSS 150.3 (Radioactive Liquid Leaks Between Buildings 771 and 774), OU8. 150 3 targets leaks from various OPWL pipes and tanks[a, b], possibly including P-21 The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides, metals and inorganic compounds at 150.3 The southernmost section of P-25 is within IHSS 127 (Low-Level Radioactive Waste Leak), OU8 127 targets a reported release from the process waste line between Buildings 774 and 995 (most likely P-28 or P-29)[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for various radionuclides and nitrate at 127 This Work Plan proposes that IHSS 127 be incorporated into OU9
P-26	B5, B6	IHSS 149 (Effluent Pipe), OU8 targets a 1980 leak from P-26 just east of Building 774, near the west end of the pipe[a, b]. The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, nitrate, and various radionuclides and metals at 149 This Work Plan proposes that IHSS 149 be incorporated into OU9 Most of P-26 is immediately north (downgradient) of IHSS 101 (Solar Evaporation Ponds), OU4, and most likely is affected by contamination from the ponds.
P-27	B5	North end terminates at OPWL tank locations T-14 and T-16, which are also IHSSs 124 (Radioactive Liquid Waste Storage Tanks), OU10, and 125 (Holding Tank), OU8 IHSSs 124 1 and 125 are the same tank IHSSs 124 and 125 target releases from three process waste tanks on the east side of Building 774 The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, HSL semi-volatiles, and various radionuclides, metals and inorganic compounds at 125 Two alluvial ground water monitoring wells downgradient of IHSS 125 are also specified This Work Plan proposes that IHSSs 124 and 125 be incorporated into OU9
P-28	B5	P-28 is within IHSS 127 (Low-Level Radioactive Waste Leak), OU8 127 targets a reported release from the process waste line between Buildings 774 and 995 (most likely P-28 or P-29)[a, b]. The IAG specifies a surface radiation survey and analysis of soil boring samples for various radionuclides and nitrate at 127 This Work Plan proposes that IHSS 127 be incorporated into OU9

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS
(Continued)

PIPE	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
P-29	B5	South end is within IHSS 127; see P-28 comments North end terminates at OPWL tank locations T-14 and T-16; see P-27 comments
P-30	B5, C5	North end terminates at OPWL tank locations T-9 and T-10, which are also IHSS 132 (Radioactive Site #4 - 700 Area), OU8 132 targets suspected leaks from these tanks[a, b]. The IAG specifies analysis of soil boring samples for nitrate and various radionuclides at 132. This Work Plan proposes that IHSS 132 be incorporated into OU9 North end also terminates at IHSS 131 (Radioactive Site #1 - 700 Area), OU14. 131 targets an area north and/or west of Building 776 (the precise location has not been determined) contaminated by plutonium during a 1969 fire[a, b] The IAG specifies analysis of soil boring samples for various radionuclides at 131.
P-31	B5	P-31 is within 150 3 (Radioactive Liquid Leaks Between Buildings 771 and 774), OU8 150 3 targets historical leaks from various OPWL tanks and pipes, including a leak in 1971 resulting from excavation of P-31 and P-56 during construction activities[a b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides, metals, and inorganic compounds at 150.3.
P-32	B5, C5	North end terminates within IHSSs 131 and 132, see P-30 comments East-west section between Buildings 776 and 778 is within IHSS 150 7 (Radioactive Liquid Leak South of Building 776), OU8. 150.7 targets an area contaminated by plutonium during a 1969 fire in Building 776[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides, metals, and inorganic compounds at 150 7
P-33	B5	None

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS (Continued)

PIPE	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
P-34	B5	North section is within IHSS 150 3; see P-31 comments. Overlain in part by OPWL tank locations T-15 and T-17, which are also IHSS 146 (Concrete Process Waste Tanks), OU8 The six tanks at this site were removed in 1970 Numerous process waste releases reportedly occurred from the tanks while they were in service[a, b]. The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, HSL semi-volatiles, and various radionuclides, metals and inorganic compounds at 146. This Work Plan proposes that IHSS 146 be incorporated into OU9
P-35	B5	West end terminates at IHSS 127 (Low-Level Radioactive Waste Leak), OU8. 127 targets a reported process waste release from the process waste line between Buildings 774 and 995[a, b]. The IAG specifies a surface radiation survey and analysis of soil boring samples for various radionuclides and nitrate at 127 This Work Plan proposes that IHSS 127 be incorporated into OU9 East end terminates at Pond 207-C of IHSS 101 (Solar Evaporation Ponds), OU4 101 targets known releases of nitrates and other chemical contaminants from the ponds[a, b] These releases most likely have affected soils around the east end of P-35
P-36	B5, B6	P-36 lies along the south side of Pond 207-C and terminates at Pond 207-A of IHSS 101 (Solar Evaporation Ponds), OU4 Releases of nitrates and other chemical contaminants from the ponds most likely have affected soils around the east end of P-36, and possibly also along the section south of 207-C, although ground water flow is towards the ponds from this location
P-37	B5, B6, C5, C6	East end terminates within IHSSs 131 and 132, see P-30 comments Sections of P-37 are immediately west and south of Ponds 207-A and 207-B of IHSS 101 (Solar Evaporation Ponds), OU4 Releases of nitrates and other chemical contaminants from the ponds may have affected soils along these sections, although ground water flow is towards the ponds from these locations A section of P-37 south of Building 779 is within IHSS 150 6 (Radioactive Liquid Leak South of Building 779), OU8 150 6 targets radioactive contamination from a 1969 waste drum leak in Building 779[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides, metals, and inorganic compounds at 150 6

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS (Continued)

PIPE	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
P-38	B5, B6, C6	A section of P-38 lies immediately west of Pond 207-A of IHSS 101 (Solar Evaporation Ponds), OU4 Releases of nitrates and other chemical contaminants from the ponds may have affected soils along this section, although ground water flow is towards the ponds from this location.
P-39	C6-C8	A section of P-39 lies immediately south of IHSS 101 (Solar Evaporation Ponds), OU4 Releases of nitrates and other chemical contaminants from the ponds may have affected soils along this section of P-39, although ground water flow is towards the ponds from this location A section of P-39 is immediately south of IHSS 176 (S&W Contractor Storage Yard), OU10 Detailed information about 176 is not given in available references
P-40	C7, C8	East end terminates at Pond B-2 of IHSS 142 (Retention Ponds), OU6 Past studies of the holding ponds have documented radionuclide accumulation (primarily plutonium) in bottom sediments[a, b] The IAG specifies analysis of sediment and water samples for HSL volatiles, HSL semi-volatiles, various radionuclides and metals, and nitrate at 142
P-41	B5, B6, C6	West end of east-west section terminates within IHSSs 131 and 132, see P-30 comments. South end of north-south section between Buildings 777 and 779 is possibly affected by low-level radioactive contamination from IHSS 144 (Sewer Line Break), OU8 144 targets suspected radioactive contamination from a sanitary sewer line break[a, b]
P-42	B5, C5	South end between Buildings 777 and 779 is possibly affected by low-level radioactive contamination from IHSS 144 (Sewer Line Break), OU8 144 targets suspected contamination from a sanitary sewer line break[a, b]
P-43	B5	IHSS 137 (Cooling Tower Blowdown, Building 774) is immediately west of P-43 Possible cooling tower blowdown water releases from this site may have contaminated soils around P-43 with low levels of chromate[a, b]
P-44	B5	P-44 parallels and is immediately adjacent to P-43, see P-43 comments
P-45	B5	None
P-46	B5	P-46 parallels and is immediately adjacent to P-35, see P-35 comments
P-47	B6	P-47 is entirely within IHSS 101 (Solar Evaporation Ponds), OU4 Soils surrounding P-47 have most likely been contaminated by releases from the ponds[a, b]

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS
(Continued)

PIPE	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
P-48	B6	P-48 is entirely within IHSS 101, see P-47 comments.
P-49	B6	P-49 is entirely within IHSS 101, see P-47 comments
P-50	B6	P-50 is entirely within IHSS 101, see P-47 comments
P-51	C5	None (inside Building 778)
P-52	E3	None
P-53	F5	P-53 parallels and is immediately adjacent to P-7; see P-7 comments
P-54	F5	N end terminates at IHSS 145 (Sanitary Waste Line Leak), OU1. 145 targets an area of possible low-level radioactive contamination from a 1981 sewer line leak at the SW corner of Building 881[a, b] The draft OU1 Phase III RI/FS Work Plan indicates that no hazardous or radioactive contaminants were released as a result of this leak, and that no further investigation of the site is necessary
P-55	F5	P-55 parallels and is immediately adjacent to P-7, see P-7 comments
P-56	B5	P-56 parallels and is immediately adjacent to P-31, see P-31 comments
P-57	E2	East end terminates at IHSS 148 (Waste Spills), OU13 148 targets nitrate and radionuclide contamination around Building 123[a, b]. The IAG specifies a surface radiation survey and analysis of soil boring samples for various radionuclides at 148

TANK	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
T-1	E2	None
T-2	E2	T-2 and T-3, a single, interconnected group of tanks, are also IHSS 122 (Underground Concrete Tanks), OU13 122 targets suspected leaks from T-2 and T-3[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, nitrate, and various radionuclides at 122 This Work Plan proposes that IHSS 122 be incorporated into OU9
T-3	E2	T-2 and T-3 are a single, interconnected group of tanks, see T-2 comments
T-4	F3	T-4 is inside Building 447, which is within IHSS 157 2 (Radioactive Site, South Area), OU12 157 2 targets contaminated soils around Building 447[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, beryllium, bis (2-ethylhexyl) phthalate, and various radionuclides at 157 2

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS (Continued)

TANK	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
T-5	E3	T-5 is inside Building 444, which is within IHSS 157.2 ; see T-4 comments The T-5 tanks are active, permitted RCRA waste units.
T-6	E3	T-6 is inside Building 444, which is within IHSS 157.2 , see T-4 comments
T-7	C4	IHSS 159 (Radioactive Site - Building 559), OU8, is immediately north of T-7 159 targets process waste leaks from pipelines on the east side of Building 559[a, b] These pipelines transferred process waste to T-7 from 559 The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides and metals at 159 This Work Plan proposes that IHSS 159 be incorporated into OU9.
T-8	B5	T-8 is also IHSS 126 (Out-of-Service Process Waste Tanks), OU8. 126 targets suspected leaks from T-8[a, b]. The IAG specifies analysis of soil boring samples for HSL volatiles, various radionuclides, beryllium and nitrate at 126 An alluvial ground water monitoring well north of the 126 site is also specified This Work Plan proposes that IHSS 126 be incorporated into OU9
T-9, T-10	B5	T-9 and T-10 are also IHSS 132 (Radioactive Site #4 - 700 Area), OU8 132 targets suspected leaks from T-9 and T-10[a, b] The IAG specifies analysis of soil boring samples for nitrate and various radionuclides at 132 This Work Plan proposes that IHSS 132 be incorporated into OU9 T9 and T10 are possibly located within IHSS 131 (Radioactive Site #1 - 700 Area), OU14 131 targets an area north and/or west of Building 776 (the precise location has not been determined) contaminated by plutonium during a 1969 fire[a, b] The IAG specifies analysis of soil boring samples for various radionuclides at 131 IHSS 118 1 (Multiple Solvent Spills West of Building 730), OU8, is located immediately west of the building which houses T9 and T10. 118 1 is the former location of an underground carbon tetrachloride storage tank which may have leaked during its operating history The tank was removed in 1981[a, b] The IAG specifies a soil gas survey of 118 1, with soil borings where the survey detects contamination
T-11, T-30	C5	None (T-11 and T-30 are active, permitted RCRA waste units)
T-12	B5	Not a valid OPWL tank location

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS (Continued)

TANK	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
T-13	B5	T-13 is located inside Building 774 IHSS 215 (Units 55 13 - 55 16, Tanks T40, T66, T67, and T68), OU15, targets three process waste tanks east of 774 (T66, T67, and T68, see T-14, T-16 comments below) as well as a fourth tank (T40) at an unknown location inside 774 It is possible that T40 is T-13 or is located near T-13. More detailed information about IHSS 215 is not given in available references.
T-14, T-16	B5	T-14 and T-16 consist of three inactive process waste tanks (designated T66, T67, and T68) located on the east side of Building 774 Two other IHSSs also address these tanks IHSS 124 (Radioactive Liquid Waste Storage Tanks), OU10, is comprised of three subparts (124.1, 124.2, and 124.3) which target T66, T67, and T68, respectively IHSS 125 (Holding Tank), OU8, also targets tank T66 This Work Plan proposes that IHSSs 124 and 125 be incorporated into OU9
T-15, T-17	B5	T-15 and T-17 are also IHSS 146 (Concrete Process Waste Tanks), OU8 146 targets releases from the six former process waste tanks which were removed in 1972[a, b] The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, HSL semi-volatiles, and various radionuclides, metals and inorganic compounds at 146. This Work Plan proposes that IHSS 146 be incorporated into OU9
T-18	C5	None
T-19, T-20, T-38	C5	None
T-21, T-22	E5	IHSS 164 2 (Building 886 Radioactive Spills), OU14, targets uranium contamination in soil around and beneath Building 886[a, b] 164 2 appears on location maps to focus on the eastern side of 886, whereas T-21 and T-22 are immediately west of 886 The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles, HSL semi-volatiles and various radionuclides at 164 2
T-23	E5	Both T-23 and IHSS 179 (Building 865 Drum Storage Area), OU15, are inside Building 865 Available references do not give the exact location of IHSS 179 or other detailed information about the site.
T-24, T-32	F5	T-24 and T-32 are possibly affected by IHSSs 106 (Outfall) and 107 (Hill-side Oil Leak), OU1 Numerous monitoring wells and boreholes have been completed in the vicinity of T-24 and T-32 in conjunction with the 881 Hillside RI T-24 and T-32 are active, permitted RCRA waste units

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS
(Continued)

TANK	LOCATION[1]	POTENTIAL INTERACTION WITH OTHER OUs[2]
T-25, T-26	E5	T-25, T-26, and IHSS 180 (Building 883 Drum Storage Area), OU15, are inside Building 883. Available references do not give the exact location of 180 or other detailed information about the site. T-25 and T-26 are active, permitted RCRA waste units.
T-27	E5	T-27 is immediately adjacent to T-21 and T-22, see T-21, T-22 comments
T-28	E5	None
T-29	B5	Chromate contamination related to IHSS 137 (Cooling Tower Blowdown, Building 774), OU8, may affect soils on the northwest side of T29.
T-31	C7	Not a valid OPWL tank location
T-33, T-34	C4	Not valid OPWL tank locations
T-35	C4	T-35 is located inside Building 528. IHSS 159 (Radioactive Site - Building 559), OU8, immediately north of 528, targets leaks from pipelines which transferred process waste from 559 to 528[a, b]. The IAG specifies a surface radiation survey and analysis of soil boring samples for HSL volatiles and various radionuclides and metals at 159. This Work Plan proposes that IHSS 159 be incorporated into OU9.
T-36, T-37	B5	None
T-39	F5	Both T-39 and IHSS 178 (Building 881 Drum Storage Area), OU15, are inside Building 881. Available references do not give the exact location of 178 or other detailed information about the site.

1 See Plate I, Original Process Waste Lines Location Map

2 RFP Operable Units have been designated as follows (DOE, 1991a)

OU1	881 Hillside	OU9	Original Process Waste Lines (OPWL)
OU2	903 Pad	OU10	Other Outside Closures (OOC)
OU3	Off-Site Releases	OU11	West Spray Field
OU4	Solar Ponds	OU12	400/800 Area
OU5	Woman Creek	OU13	100 Area
OU6	Walnut Creek	OU14	Radioactive Sites
OU7	Present Landfill	OU15	Inside Building Closures
OU8	700 Area	OU16	Low Priority Sites

TABLE 2.3

POTENTIAL OPWL INTERACTIONS WITH OTHER RFP OPERABLE UNITS (Continued)

3 Rocky Flats Interagency Agreement (DOE, 1991a)

References

a DOE, 1986a

b Rockwell International, "Appendix I RCRA 3004(u) Waste Management Units, Volume 1," CODO78343407, Revision 0, 17 October 1986

TABLE 2.4

RFP IHSSs TARGETING KNOWN OR SUSPECTED OPWL RELEASE SITES

IHSS Name	IHSS No.	OU No	Description
Underground Concrete Tank(s)	122	13	Abandoned OPWL tank behind Building 441
Valve Vault West of Building 707	123 2	8	Site of OPWL valve vault (original valve vault #7) removed in March 1973
Radioactive Liquid Waste Storage Tanks	124	8	Three abandoned OPWL tanks east of Building 774, tank 66 (124.1), tank 67 (124.2), and tank 68 (124 3)
Holding Tank	125	8	Tank 66 east of Building 774, same tank as IHSS 124.1
Out-of-Service Process Waste Tanks	126	8	Two abandoned OPWL tanks (126.1 and 126 2) in process waste pit (Building 728) north of Building 771
Low-Level Radioactive Waste Leak	127	8	OPWL pipeline between Buildings 774 and 995 broken during construction activities near Building 774
Radioactive Site - 700 Area Site #4	132	8	Four abandoned OPWL tanks in laundry waste pit (Building 730) north of Building 776
Concrete Process Waste Tanks	146	8	Six removed process waste tanks (146 1 - 146 6) beneath the south wing of Building 774
Maas Area	147 1	12	Multiple releases from OPWL pipeline between Building 774 and 400/800 Areas
Effluent Pipe	149	8	OPWL pipeline between Building 774 and Solar Ponds which leaked due to gasket failure in July 1980
Radioactive Site - Building 559	159	8	Multiple releases from broken pyrex glass OPWL pipelines beneath and around Building 559

TABLE 2.5

COMPARISON OF ROCKY FLATS ALLUVIUM HYDRAULIC PROPERTIES

Source	Hydraulic Conductivity (cm/s)
Ground Water Assessment Plan Addendum - Draft EG&G, 1990	5.3×10^{-4} - $2 1 \times 10^{5}$ [a]
Hydrogeological Characterization of the Rocky Flats Plant Hydro-Search, 1985	1×10^{3} [b]
Section E Ground Water Protection Rockwell International, 1986	7×10^{5} [c]
Draft Final Ground Water Protection and Monitoring Plan EG&G, 1991	6×10^{5} [d]
RCRA Part B Permit Application DOE, 1987	7×10^{-5} [c]
Hydrology of a Nuclear-Processing Plant Site Hurr, 1976	1×10^{-2} [e]
RCRA Post-Closure Care Permit Application DOE, 1988	9×10^{-6} - 4×10^{-8} [f]

Source Draft Final Rocky Flats Plant Geologic Characterization Report (EG&G, 1991c)

a Range of measurements in wells at three RFP RCRA-regulated units (West Spray Field, Solar Evaporation Ponds, and Present Landfill)

b Estimate based on drawdown-recovery tests on three RFP wells and on observed physical properties of Rocky Flats Alluvium

c Average of measurements from monitoring wells at various locations within RFP

d Average of measurements in wells at three RFP RCRA-regulated units (West Spray Field, Solar Evaporation Ponds, and Present Landfill)

TABLE 2.5

COMPARISON OF ROCKY FLATS ALLUVIUM HYDRAULIC PROPERTIES
(Continued)

e Estimate, apparently based on physical properties of Rocky Flats Alluvium and infiltration rate calculated from one or more RFP monitoring wells

f Range of measurements from monitoring wells at various locations within RFP

TABLE 2.6

OPWL WASTE STREAM CHARACTERIZATION

BLDG	BUILDING FUNCTION	OPWL WASTE STREAM CHARACTERISTICS
122	Medical facility	Personnel decon water: bleach, soap, blood, hydrogen peroxide, trace radionuclides from contaminated personnel
123	Health Physics analytical laboratory--analysis of environmental samples, bioassays	Acids HNO_3, HF, H_2SO_4, HCl, $C_2H_4O_2$, $HClO_4$ Bases NH_4OH, NaOH Solvents: Acetone, alcohols, cyclohexane, toluene, xylenes, triisooctomine, ether Rads: Various isotopes of Pu, Am, U, Cm Metals Be (trace amounts) Others. Ammonium thiocyanate, ethylene glycol, possible trace PCBs from experimental work No pesticides or herbicides
441	Analytical laboratory until converted to offices in approximately 1961	No specific information available
443	Steam plant--produces steam for heating and evaporator operation	H_2SO_4, NaOH are only known wastes No metals, radionuclides, oils, solvents, PCBs, pesticides, herbicides
444	Machining, foundry, plating, also contains a drum decontamination and cleaning station	Acids H_3PO_4, HNO_3, HCl, H_2SO_4, HF, H_2CrO_4, oxalic, cyanic Bases NaOH, KOH, NH_4OH, CaOH Solvents TCA, TCE, PCE, freon Rads U-238 only Metals Numerous, including Ag, Au, Cr (including Cr^{+6}), Ta, Ni, Cd, Pt, Pb, Ti, Zn, Cu, Sn, W, Fe, Hg, Be (trace) Others Fluoride, lubricating oil, cutting oil, lathe coolant (mix of oil and CCl_4) No PCBs, pesticides, or herbicides.
447	Heat treatment (U chip roasting), welding/foundry, storage	Oakite (cleaning compound), trace U from equipment decon, Be, cutting oil are only known wastes No acids, bases, solvents, PCBs, pesticides, or herbicides.

TABLE 2.6

OPWL WASTE STREAM CHARACTERIZATION
(Continued)

BLDG	BUILDING FUNCTION	OPWL WASTE STREAM CHARACTERISTICS	
559	Analytical laboratory--supports Pu recovery, foundry and fabrication operations	Acids.	HNO_3, HCl, H_2SO_4, HF, H_2CrO_4
		Bases·	NH_4OH, NaOH, KOH
		Solvents:	Acetone, CCl_4, chloroform, 1,1,1 TCA, TCE, freon
		Rads	Primarily Pu, with lesser amounts of Am, U
		Metals.	Numerous metals used in preparation of standards. Primary metals used include Cu and Cr
		Others	Very slight chance of PCBs, pesticides, or herbicides
707	1st floor Plutonium production--machining, casting/foundry, assembly 2nd floor Utilities services	Acids	None identified
		Bases·	None identified
		Solvents	CCl_4, TCA, TCE, chloroethane, freon
		Rads	Pu, Am, U
		Metals	Pb, Be, Ta, Ca, Li
		Others.	Fluoride (from CaF_2), chloride (from LiCl), machine oils, lubricating oil, lathe coolant (mix of oil and CCl_4), ethylene glycol No PCBs, pesticides, or herbicides
771	Plutonium and uranium recovery--includes support laboratory and Ektamatic photographic processing	Acids	HNO_3, HCl, H_2SO_4, H_3PO_4, HF, $C_2H_4O_2$
		Bases	NH_4OH, NaOH, KOH, MgOH, CaOH
		Solvents	Cyclohexane, chloroform, xylene, tri-n-octyl phosphine-oxide, PCE, TCA, TCE
		Rads	Various isotopes of Pu, Am, U (more U-235 than U-238), very slight possibility of tritium
		Metals·	Pb, Hg, Ni, Cr (including Cr^{+6}), Ti, Ce, Ta, Cu
		Others	No 2 and No 6 fuel oil, lubricating oil Slight possibility of PCBs No pesticides or herbicides Photo lab wastes may have included sodium sulfide, potassium sulfide, sodium sulfate, sodium acetate, ammonium thiocyanate, alum, Photo-Flow (trade name)

TABLE 2.6

OPWL WASTE STREAM CHARACTERIZATION
(Continued)

BLDG	BUILDING FUNCTION	OPWL WASTE STREAM CHARACTERISTICS	
774	Process waste treatment facility	Acids	HNO_3, H_2SO_4, HF
		Bases	NaOH, KOH
		Solvents.	Small amounts of various solvents
		Rads	Various isotopes of Pu, Am, U
		Metals	Fe, Cr (including Cr^{+6}), Hg, Ni, Ta
		Others	Chlorides, small amounts of various oils and grease. No PCBs, pesticides or herbicides
776	Production and support activities--pyrochemical Pu recovery, utilities, maintenance	Acids.	None identified
		Bases.	None identified
		Solvents:	CCl_4, TCA, TCE, toluene
		Rads	Various isotopes of Pu and Am, tritium (no U)
		Metals	Cd, Cr
		Others	Small amounts of machining and lubrication oils. No PCBs, pesticides or herbicides
777	Production and support activities--machining, assembly, support laboratories	Same as Building 776	
778	Laundry	Laundry water Detergent, Pu, Am, U	
779	Research and development--uses have included metallurgy, photographic processing, various analytical laboratories	Acids	HNO_3, HCl, H_2SO_4, H_3PO_4, HF, H_2CrO_4, oxalic
		Bases	NH_4OH, NaOH, KOH, CaOH
		Solvents:	Alcohols, CCl_4, toluene, xylenes, TCA, TCE, PCE, acetone, chloroform, freon, kerosene
		Rads	Primarily Pu and Am, very slight possibility of U-238 No tritium
		Metals	Numerous metals from metallurgy work, likely included Be, Cr, Ni, Au, Cd, Pb, Fe, Ag, Pt, Ti, Ta, Zn, Cu, Sn, W, Mn, Mg
		Others	Possible lubricating oil No PCBs, pesticides or herbicides

TABLE 2.6

OPWL WASTE STREAM CHARACTERIZATION
(Continued)

BLDG	BUILDING FUNCTION	OPWL WASTE STREAM CHARACTERISTICS	
865	Metallurgy research and development	Acids	HNO_3, HCl, HF, H_2SO_4, H_2CrO_4
		Bases.	NaOH, NH_4OH
		Solvents	Alcohols, acetone, TCE, possibly numerous others
		Rads·	U-238 only
		Metals	Numerous metals from metallurgy work, likely included Be, Cr, Ni, Pb, Pt, Ti, Ta, Zn, Cu, Sn, W
		Others	Possible lubricating oil, hydraulic oil No PCBs, pesticides or herbicides
881	Originally an enriched uranium (U-235) reprocessing facility Converted to stainless steel machining between 1968 and 1983. Currently a general analytical laboratory and offices.	Acids	HNO_3, H_3PO_4, HF, H_2SO_4
		Bases.	NaOH, KOH
		Solvents·	CCl_4, TCA, TCE, freon
		Rads	U, Pu, Am (no tritium); also possibly Np-237
		Metals	Hg, Cr, Ni, Mo, Mn, Fe
		Others	Possible lubricating oil, grinding oil. Very slight chance of PCBs. No pesticides or herbicides
883	Metalworking	Acids	None identified
		Bases	KOH
		Solvents	TCA, possibly others
		Rads	U-235 and U-238 only
		Metals	Possible Be
		Others	Oakite (cleaning solution) may have been used in past No PCBs, pesticides or herbicides
886	Critical mass laboratory	Laboratory soaps, janitorial cleaning fluids, U-235 (only) and possibly nitrates. No acids, bases, metals, organic solvents or oils, PCBs, pesticides, or herbicides	

TABLE 2.6

OPWL WASTE STREAM CHARACTERIZATION
(Continued)

BLDG	BUILDING FUNCTION	OPWL WASTE STREAM CHARACTERISTICS	
889	Solid waste size reduction facility	Acids	Possible H_2SO_4 from scrap batteries
		Solvents:	Paint solvents (trade names PASO, PESO)
		Rads	U-238 only
		Metals	Pb, Be
		Others	Detergents, soap, grease from cleaning No PCBs, pesticides or herbicides.

Source RFP personnel interviews conducted from September 13 through October 1, 1991

TABLE 2.7

RESULTS OF 1976 SOIL SAMPLING OPWL AREA[a]

Sampling Location	NO_3 (ppm)	Pu^{239} (pCi/g)
32 feet north of NW corner of Building 663	62	0 017
West of Building 884 and east of P-6 and P-9	110	0 022
West of SW corner of Building 707 and east of P-12	54	0.065
Between Buildings 777 and 778, near where P-14 enters Building 778	148	0 218
8 feet east of easternmost edge of Tank 207	70	0.083
~30 feet north of northernmost edge of Tank 207 and ~4 feet east of P-27 and P-28	76	0 824
Near intersection of P-24 and P-25, north of Buildings 771 and 774	44	1 523
1989 background values for Rocky Flats Alluvium[b]	1 1-4 3	0 03(0 03)-0.01(0.02)[c]

a Reference. Sunday, G , 1976, Appendix C herein
b EG&G, 1991d
c Background values include Pu^{239} and Pu^{240} Values in parentheses are counting uncertainties

TABLE 2.8

CALCULATION OF CONTAMINANT SPREAD FOR PIPELINE RELEASE CONCEPTUAL MODEL

<u>Purpose</u>

Estimate the likely initial spread of contamination from an underground OPWL pipeline leak.

<u>Assumptions</u>

- Leak volume of 500 gallons
- Contaminant flow is lateral through pipe trench materials
- Infiltration into native soil surrounding trench is negligible
- Contaminant fully saturates trench fill material (i e , effective porosity = actual porosity)
- Affected trench cross section = 3 ft x 0 5 ft
- Trench fill material properties [a]
  - Dry weight = 115 lb/ft^3
  - Water content = 10 percent by dry weight
  - Porosity = 35 percent = 0 35 ft^3 per 1 0 ft^3 fill
- Conversion factors for water and process waste. 7.48 gal/ft^3, 62 4 lb/ft^3

<u>Leak Volume</u>

500 gal / 7 48 gal/ft^3 = 66 8 ft^3

<u>Volume of Water in Trench Fill</u>

Let weight of fill = X

Weight of water in fill = 10 percent of X = 0 1X

(Weight of fill) - (Weight of water) = (Dry weight of fill)

X - 0 1X = 115 lb/ft^3

X = 115 lb/ft^3 / 0.9

X = 127 78 lb/ft^3

Weight of water = (0 1) (127 78 lb) = 12 78 lb/ft^3

Volume of water = 12 78 lb/ft^3 / 62 4 lb/ft^3 = 0 205 ft^3 water per 1 0 ft^3 fill

TABLE 2.8

CALCULATION OF CONTAMINANT SPREAD FOR PIPELINE RELEASE CONCEPTUAL MODEL
(Continued)

Unsaturated (available) Porosity

(0.35 ft^3 porosity / 1.0 ft^3 fill) - (0.205 ft^3 water / 1.0 ft^3 fill)

= 0.145 ft^3 available porosity / 1 0 ft^3 fill

Length of Affected Trench Fill

(66 8 ft^3 liquid / 1 5 ft^2 cross section) / 0 145 ft^3 available porosity = 307 ft

a Properties obtained from 1988 OPWL Closure Plan (DOE, 1988)

Approved By

______________________ __/__/__
Work Plan Manager (Date)

______________________ __/__/__
Division Manager (Date)

Effective Date ______________

5.0 RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION TASKS

5 1 TASK 1 - PROJECT PLANNING

Project planning for the implementation of the Phase I RFI/RI for OU9 will include numerous activities in addition to tasks completed as part of this Work Plan Review of previous site investigations, preliminary site characterization, preliminary identification of potential ARARs and the development of DQOs and a FSP have all been completed as part of this Work Plan and are contained in Sections 2 0, 3 0, 4 0, and 7 0, respectively

Additional planning will be required to coordinate preparatory activities for OU9, other field investigation programs occurring in the same vicinity, and to accommodate the special security requirements within the Protected Area (PA) and health and safety concerns The complex nature of the OPWL network and the degree of uncertainty regarding its location in some areas will require preparatory activities to (1) fully and accurately delineate the OPWL network, (2) better understand areas of past releases, and (3) obtain information on construction activities that may have disturbed soils surrounding the OPWL or removed portions of the OPWL

Prior to RFI/RI field activities, newly generated data and historical data which has become available since preparation of this Work Plan will be compiled and evaluated (Section 7 2 4) There are ongoing site investigation studies which may provide data relevant to the OU9 investigation The HRR project has assembled a database and file of supporting documents that contain information regarding past releases This database will be queried, and all releases related to the OPWL will be reviewed and used in the design of the FSP Personnel interviews will be conducted to augment past release information and to identify areas where construction activities have disturbed and/or removed portions of the OPWL An OPWL site walk will be performed to provide additional location and accessibility information In addition, personnel in facility operations will be contacted to inquire about any additional information that may be available about OPWL structures and site conditions. A detailed discussion of these additional data compilation activities is provided in Section 7 2 4

Field activities proposed for OU9 will be integrated with ongoing or proposed field activities for other overlapping investigation sites to minimize redundancy and maximize efficiency The possible overlaps between the OPWL and other RFP OUs are discussed in detail in Table 2 3

It is important to emphasize that project planning and coordination will be required throughout the project duration as unforeseen developments occur

Two project planning documents, including this Work Plan, have been prepared for the OU9 Phase I RFI/RI as required by the IAG A FSP included in this document presents the locations, media, and frequency of sampling efforts The second document required by the IAG is a SAP, which includes a QAPjP and OPs for all field activities The QAPjP and OPs are being revised in accordance with the IAG

5 2 TASK 2 - COMMUNITY RELATIONS

In accordance with the IAG, the RFP has developed a Community Relations Plan (CRP) to inform and actively involve the public in decision-making as it relates to environmental restoration activities. Accordingly, a site-specific CRP is not required for OU9 The vehicle for public involvement in the RFI/RI process is through the Technical Review Group process The CRP addresses the needs and concerns of the surrounding communiti s identified through interviews with federal, state, and local elected officials, businesses, medical professionals, educational representatives, interest groups; media, and residents adjacent to the RFP

Current community relations activities concerning environmental restoration include participation by RFP representatives in informational workshops, presentations at meetings of the Rocky Flats Environmental Monitoring Council, briefings for citizens, businesses, and surrounding communities on environmental restoration and monitoring activities, and public comment opportunities on various EM Program plans and actions RFP personnel involve several special interest groups in decisions that pertain to environmental restoration activities, including the Rocky Flats Cleanup Commission, the recipient of the EPA Technical Assistant Grant

In addition, a Speakers' Bureau program provides RFP speakers to civic groups and educational organizations, and a public tours program allows the public to visit the RFP The RFP also produces fact sheets and periodic updates on environmental restoration activities for public information and responds to numerous public inquiries regarding the RFP

5 3 TASK 3 - FIELD INVESTIGATION

The Phase I RFI/RI field investigation is designed to meet the objectives outlined in Section 4 0 Additionally, the data will be used to support the Phase I Environmental Evaluation and the Phase I Baseline Human Health Risk Assessment The activities described below will be performed as part of the field investigation, as described in detail in Section 7 0

The scope of the Phase I field investigation is to locate the buried pipelines, characterize the contaminant sources, and characterize the nature and extent of vadose-zone surficial deposits contamination for the active but unpermitted, inactive, and removed tanks, and the approximately 18,000 feet of abandoned pipelines which are not overlain by buildings Also, OPWL components overlain by buildings will be evaluated for partial accessibility and will be investigated to the extent possible

The Phase I field investigation will include the following subtasks conducted in sequential stages

- Subtask 1 - Facility Coordination and Mobilization During the mobilization for field work, detailed planning to coordinate with facility operations will be performed

- Subtask 2 - Tank and Pipeline Investigations
  - 2 a - Tank Inspection and Residue Sampling Chemical characterization will be performed of residual inventory, if any, in the process waste tanks which have not been cleaned or removed In tanks without inventory, wipe (smear) samples will be taken to provide a qualitative indication of radioactive contamination
  - 2 b - Pipeline Locating, Inspection and Residue Sampling The pipelines which are not overlain by buildings will be located by test pits, and pipe locator devices if necessary, and mapped by surveying Any inventory remaining in the pipes at the test pit locations will be sampled, if possible, for chemical analyses to be used in remedial planning Sampling of soils immediately beneath the pipelines will be conducted at the same time (see below)
- Subtask 3 - Soil Sampling: Soils for chemical analysis will be sampled from pipeline release areas and around tank locations

5 3 1 Subtask 1 - Facility Coordination and Mobilization

Detailed coordination with facility operations, facility health and safety, the radiation monitoring department, the waste management department, and plant security will be performed during mobilization for the field activities, because the OU9 investigation work will take place in sensitive areas The OPs will be amended as necessary to include procedures for sampling of tanks and pipelines A detailed health and safety plan will be prepared for the OU9 investigation activities by the contractor that implements the Work Plan Utility surveys will be conducted to locate active buried utilities

Surface radiation surveys will be performed at all OPWL release sites known or suspected to have impacted surface soils The results of these surveys will be used to focus intrusive sampling activities at these sites This activity is described in Section 7 2 5

5 3 2 Subtask 2 - Tank and Pipeline Investigation

5 3 2 1 Tank Inspection and Residue Sampling

All tanks identified in Table 2 2 that have not been removed or converted to the new process waste system will be inspected to confirm that no waste inventory remains in the tanks Should residue be encountered, a residue sample will be collected In tanks with no visible contamination, wipe (smear) samples will be collected to evaluate for possible residual radioactive contamination In addition, inside surface radiological dose rates will be measured. The analytical results will be used for planning tank decontamination or remediation activities Section 7.3.2 1 describes the tank inspection and residue sampling activities in detail

5.3 2 2 Pipeline Locating, Inspection, and Residue Sampling

Pipeline locations will be verified by excavating test pits to expose each line (Section 7 3 1 1). This will permit positive identification of the line, along with exact location and depth The pits will be spaced as necessary to trace the lines and conduct soil sampling (see below) The pit excavations will be located to minimize interference with other utilities, structures, and plant operations

The pipelines will be inspected for remaining inventory which could act as a source of contamination Where other access is not available, the pipe will either be cut open or dismantled at test pit exposures Detailed procedures for this activity will be addressed in EMD OP revisions (Section 11 0)

If any residue remains in the pipes where they are opened, the residue will be sampled, if possible Where no waste residue is present, wipe (smear) samples will be taken on the interior surfaces of the pipeline In addition, inside surface radiological dose rate measurements will be performed

If groundwater is encountered in a test pit, a sample will be collected and submitted for analysis Soil samples will be collected, if possible (Section 7 3 1 1), however, no attempt will be made to open the pipeline and collect a residual waste sample

Pressure testing will be performed on accessible and compatible pipeline sections Pressure testing procedures will be developed by the contractor that performs the testing Section 7 3 1 1 provides a more detailed discussion of pipeline pressure testing

5 3 3 Subtask 3 - Soil Sampling

Soil sampling will be conducted around all accessible tank locations and OPWL pipeline release areas (Section 7 3) Soil sampling will be performed in a two-stage approach for tanks and a three-stage approach for pipelines Stage 1 soil sampling will be conducted concurrently with pipeline locating, inspection, and residue sampling and will be a source characterization which focuses on residual contamination in OPWL components and on vadose zone soils immediately surrounding OPWL Stage 2 will be a vadose zone soils characterization which defines the lateral and vertical extent of contamination in vadose zone soils at contaminated areas identified in Stage 1 For pipelines, the need for additional Stage 3 sampling to further define the extent of vadose zone soil contamination will be determined on a case-by-case basis

Sampling locations, frequency, and analyses are discussed in the FSP (Section 7 0). All field activities will be performed in accordance with RFP EM Program OPs unless otherwise noted in the FSP

5 3 3 1 Soil Sampling Along Pipelines

The soil sampling plan for the pipelines is based on the pipeline release conceptual model and information derived from data compilation activities and field observations The soil sampling along pipelines will be performed at prescribed intervals out to the ends of the lines, whether or not the lines connect to an IHSS which is under separate investigation

Selection of the initial sampling locations along the pipelines will be based on known historical release locations, locations susceptible to releases (e g , valves elbows, joints, etc), the pipeline release conceptual model, accessibility of pipelines, and the results of the radiation screening surveys in Stage 1 Sections 7 3 1 2 and 7 3 1 3 contain detailed pipeline soils investigation discussions

5 3 3 2 Soil Sampling Around Tanks

The soil sampling plan for tanks will be based on the tank release conceptual model and information derived from data compilation activities and field observations At the location of each outdoor tank or group of tanks, soils will be sampled from vertical borings drilled next to the tanks Selection of the initial tank sampling locations will be based on known historical release information, locations susceptible to releases (e g , external connections and openings, joints, seams, etc), and the conceptual model for tank releases Section 7 3 2 contains a detailed tank soils investigation discussion

5 4 TASK 4 - SAMPLE ANALYSIS AND DATA VALIDATION

Analytical procedures will be completed in accordance with the ER Program QAPjP (EG&G, 1991f) Analytical detection limits, sample container and volume requirements, preservation requirements, and sample holding times are discussed in Section 7 4

Results of data review and validation activities will be documented in data validation reports EPA data validation functional guidelines will be used for validating organic and inorganic (metals) data (EPA, 1988c) Data validation methods for radiochemistry and major ions data have not been published by EPA, but data and documentation requirements have been developed by EM Program QA staff Data validation methods for these data are derived from these requirements. Details of the data validation process are described in the QAPjP (EG&G, 1991f)

Phase I data will be reviewed and validated according to data validation guidelines in the QAPjP and the Data Validation Functional Guidelines (EG&G, 1990d) These documents state that the results of data review and validation activities will be documented in data validation reports

5 5 TASK 5 - DATA EVALUATION

Data collected during the Phase I RFI/RI, as well as previously collected data, will be incorporated into the existing RFEDS database and will be used to better characterize contaminant sources and soil These results also will be used in delineating th requirements for the Phase II RFI/RI plans for determining the impact of OU9 on surface water, ground water, sediments, air, the environment, and biota, as well as the potential contaminant migration pathways at OU9 Additionally, data will be used to support the evaluation of proposed remedial alternatives and the BRA

5 5 1 Site Characterization

The additional physical data collected during Phase I will be incorporated into the existing site characterization Water-level data will be used to characterize the alluvial ground water flow regime

5.5.2 Source and Soils Characterization

Analytical data from tanks, pipes, and soil samples will be used to

- Characterize the nature of source contaminants
- Characterize the lateral and vertical extent of source contaminants in vadose zone soils
- Evaluate on-site contaminant concentrations

Analytical data obtained from samples of soil, residual process waste and smear samples will be used to characterize the sources of contamination Data will be summarized graphically and/or in tabular form to assist interpretation If appropriate, contaminant isopleth maps will be prepared to summarize the spatial distribution of source and soil contaminants

The criteria for the identification of contamination will be analyte-specific for each geologic unit (e g , Rocky Flats Alluvium, Colluvium, or artificial fill) For all analytes (including radionuclides), only those concentrations that exceed the site-specific background concentrations will be considered likely evidence of contamination These data will be compared to sitewide background values provided in the Final Background Geochemical Characterization Report (EG&G, 1991d).

5 6 TASK 6 - PHASE I BASELINE RISK ASSESSMENT

As required by the IAG, a BRA that will address the risk associated with source and soils will be performed as part of the Phase I RFI/RI report This task includes a Baseline Human Health Risk Assessment and Environmental Evaluation for OU9 The purpose of the BRA is to assess the potential human health and environmental risks associated with the site and to provide a basis for determining whether remedial actions are necessary In accordance with the IAG, risks will be calculated at the source The Baseline Human Health Risk Assessment will address potential public health risks, and the Environmental Evaluation will address environmental impacts

Existing data and data collected during the Phase I RFI/RI will be used to the extent possible to support the quantitative Baseline Human Health Risk Assessment and Environmental Evaluation As described in Section 2 5 4, data collected during Phase I will support quantitative evaluation of risk due to soil ingestion, inhalation, and dermal contact Exposure pathways involving surface water, groundwater, and/or biota as transport media will be quantitatively evaluated, if necessary, during Phase II The Phase I RFI/RI sampling program will be designed to generate data that meet the requirements set forth in Guidance For Data Useability In Risk Assessment (EPA, 1990a).

These assessments will aid in the preliminary screening of site remedies based on the contaminants of concern and the environmental media associated with potential risks to public health and the environment The risk assessment process will be accomplished in four general steps:

1 Data collection/evaluation (identification of contaminants of concern)

2 Exposure assessment

3 Toxicity assessment

4 Risk characterization

As stated in the IAG and the NCP, a risk characterization of current, future, or potential site conditions (no action alternative) scenarios will be developed

Task 7 (Section 5 7) will be performed concurrently with all RFI/RI Phases, and if the Baseline Human Health Risk Assessment and Environmental Evaluation determine that risks posed by contamination at OU9 must be remediated, Task 8 (Section 5 8) will be conducted.

The objectives and the description of work for the Baseline Human Health Risk Assessment are described in detail in Section 8 0 The EEWP is presented in Section 9 0

5 7 TASK 7 - DEVELOPMENT, SCREENING, AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

5.7 1 Remedial Alternatives Development and Screening

This section identifies potential technologies applicable to remediation of contaminated soils, sediments, pipes, tanks, surface water, and ground water at OU9 The identified technologies are based on the preliminary site characterization developed in Section 2 0 Identification and screening of technologies, assembling an initial screening of alternatives, and identification of interim response actions will be conducted while the Phase I RFI/RI is being conducted However, investigation of OU9 is in its early stages, thus, remedial alternatives are only briefly reviewed in this section. A more detailed evaluation of the remedial alternatives for OU9 will be performed as more data are collected

The process employed to develop and evaluate alternatives for OU9 will follow guidelines provided in the NCP Although RCRA regulations will direct remedial investigations at OU9, the CERCLA process will also be considered for guidance because it specifies in greatest detail the steps that should be followed for selection of remedial alternatives In addition, the IAG requires general compliance with both RCRA and CERCLA guidance

The steps followed to develop remedial alternatives for OU9 are as follows·

1 Develop a list of general types of actions appropriate for OU9 (such as containment, treatment, and/or removal) that may be implemented to ensure compliance with both RCRA and CERCLA guidance These general types or classes of actions are generally referred to as "general response actions" in EPA guidance

2 Identify and screen technology groups for each general response action Screening will eliminate groups that are not technically feasible at the site

3 Identify and evaluate process options for each technology group to select a process option representing each technology group under consideration. Although specific process options are selected to represent a technology group for alternative development and evaluation, these processes are intended to represent the broader range of options within a general technology group

4 Assemble the selected representative technologies into site closure and corrective action alternatives for OU9 that represent a range of treatment and containment combinations, as appropriate

5 Screen the assembled alternatives in terms of the short- and long-term aspects of three broad criteria effectiveness, implementability, and cost Because the purpose of the screening evaluation is to reduce the number of alternatives that will undergo thorough and extensive analysis, alternatives will be evaluated in less detail than subsequent evaluations

6 Develop preliminary cancer risk-based remedial action goals for affected media. Preliminary remedial action goals will be applied as performance objectives for evaluating the effectiveness of specific technology processes identified as candidate components of viable remedial action alternatives Consistent with the NCP, preliminary remediation goals will be established at a 1 x 10^{-6} excess cancer risk point of departure evaluated at the source As the CMS/FS evolves, preliminary remediation goals may be revised to a different risk level on the basis of consideration of appropriate factors that include, but are not limited to, exposure, uncertainty, and technical issues

7 Remediation goals associated with toxic, non-cancer risk will be determined using the appropriate reference dose for each chemical present on the site A Hazard Index (HI) will then be calculated If the HI exceeds 1 0, further investigation of preliminary remediation goals will be evaluated In general, if the HI is less than 1 0, a toxic risk does not exist at the site

For the Phase I RFI/RI Work Plan, the appropriate level of alternatives analysis is the listing of general response actions most applicable to the type of site under investigation General response actions are defined as those broad classes of actions that may satisfy the objectives for remediation defined for OU9 Table 5 1 provides a list and description of general response actions and typical technologies associated with remediating soils, sediments, pipes, tanks, ground water, and surface water Table 5 1 also includes a general statement regarding the applicability of the general response action to potential exposure pathways Not all of the alternative response actions and typical technologies listed may be appropriate for OU9 Some may be discarded during the screening of alternatives

The response actions outlined in Table 5 1 must be applied to the potential exposure pathways that will be identified for OU9 The response actions can be capable of providing control over all or some of the potential pathways Partially effective response actions can be combined to form complementary sets of response actions that provide control over all pathways

In general terms, potential human exposure can be avoided by prevention of contaminant release, transport, and/or contact Thus, application of the response actions may be considered at three different points in each potential exposure pathway (1) at the point where the contaminant could be released from the source, (2) in the transport medium, and (3) at the point where the contact could occur with the released contaminant

The existing data do not adequately characterize the source, release mechanisms, and migration pathways for contamination at OU9 Therefore, the existing data are not sufficient for implementing the screening of alternatives Phase I will generate data (Table 5 2) necessary to characterize the source and soils (as defined in Section 1 0) Phase II of the RFI/RI will evaluate the impact of OU9 on surface water, ground water, air, sediments, the environment, and biota in addition to characterizing potential contaminant migration pathways Data obtained from these investigations will

- Describe the physical characteristics of the site
- Define sources of contamination
- Determine the nature and extent of contamination in soil, ground water, surface water, air, and biota
- Describe contaminant fate and transport
- Describe receptors

These data will provide information for the preliminary screening of alternatives and a thorough, comparative evaluation of the technologies with respect to implementability, effectiveness, and cost This information will allow for informed decisions to be made with respect to the selection of preferred technologies The FSP (Section 7 0) describes the methodology that will be followed to obtain the required information for the Phase I RFI/RI characterization.

5 7 2 Detailed Analysis of Remedial Alternatives

Sufficient data may not be generated during the Phase I investigation to allow for a detailed analysis of alternatives The detailed analysis of each alternative will be performed when sufficient data are generated during Phase II The detailed analysis and selection of alternatives is the process of analyzing and comparing relevant information in order to select a preferred remedial action Each appropriate alternative will be assessed in terms of nine evaluation criteria, and the assessments will be compared to identify the key attributes among the alternatives Assessment in terms of eight evaluation criteria is necessary for the CMS and the subsequent Corrective Action Decision (CAD)/Record of Decision (ROD) The nine specific evaluation criteria are as follows

1 Overall protection of human health and the environment

2 ARARs

3 Long-term effectiveness and permanence

4 Reduction of toxicity, mobility, or volume

5 Short-term effectiveness

6 Implementability

7 Cost

8 State acceptance

9 Community acceptance

These criteria are described in recently revised guidelines provided in the NCP The first two criteria are considered threshold criteria because they must be evaluated before further consideration of the remaining criteria The next five criteria are considered the balancing criteria on which the analysis is based. The final two criteria are addressed during the final decision-making process after completion of the CMS/FS

5 8 TASK 8 - TREATABILITY STUDIES/PILOT TESTING

The primary purposes of a treatability study are to provide sufficient technology performance information and to reduce cost and performance uncertainties to acceptable levels so that treatment alternatives can be fully developed and evaluated during detailed analysis The task includes efforts to evaluate whether treatability studies are necessary and, if so, to prepare for and conduct treatability studies If remedial alternatives are developed, the data collected as part of the field investigation will be reviewed in terms of whether the alternatives can be evaluated If additional data are required, treatability studies or field investigations will occur

If it is determined that a treatability study is necessary, a treatability Work Plan will also be prepared The plan will identify treatability tests that need to be conducted as well as the test materials and equipment needed

The treatability Work Plan will discuss the following

- The scale of the treatability study
- Key parameters to be varied and evaluated, and criteria to be used to evaluate the tests
- Specifications for test samples, and the means for obtaining these samples
- Test equipment and materials, and procedures to be used in the treatability test
- Identification of where and by whom the tests and any analytical services will be conducted, as well as any special procedures and permits required to transport samples and residues and conduct the test
- Methods required for residue management and disposal
- Any special QA/QC needed for the tests

5 9 TASK 9 - PHASE I RFI/RI REPORT

The Phase I RFI/RI report will be prepared to consolidate and summarize the data obtained during the Phase I fieldwork as well as data collected from previous and ongoing investigations The Phase I RFI/RI report will consist of a Preliminary Site Characterization Summary and a BRA of the OPWL waste management unit components and adjacent vadose-zone soils This report will

- Describe the field activities that serve as a basis for the Phase I RFI/RI report This will include the scope of the Phase I investigation and any deviations from the Work Plan that occurred during implementation of the field investigation

- Discuss site physical conditions based on existing data and data derived during the Phase I RFI/RI This discussion will include surface features, climate, surface water hydrology, surficial geology (vadose-zone soils), geotechnical soil index properties and classification, stratigraphy, ground water hydrology, demography and land use, and ecology

- Present site characterization results from all Phase I RFI/RI activities to characterize the site physical features and contamination including nature and extent at OU9 The media to be addressed will be limited to contaminant source and vadose zone soils. This will include OPWL location information such as survey coordinates, depth of burial, location maps, and OPWL unit characteristics including the condition of pipes and tanks The discussion of the nature and extent of contamination will include the presence of inventory or residual contamination and waste characteristics related to tanks and pipes Nature and extent of vadose zone soils contamination will include types of contaminants, extent of contamination (maps), and distribution of contaminant concentrations (maps)

- Discuss contaminant fate and transport based on existing information This discussion will include a preliminary identification of potential contaminant migration routes, release sources and mechanisms, and a discussion of contaminant persistence, chemical attenuation processes, and potential receptors

- Present a Phase I BRA The BRA will include human health and environmental evaluations

- Present a summary of findings and conclusions

- Identify data needs for Phase II of the RFI/RI, if necessary

Before submittal of the Phase I RFI/RI report, the Preliminary Site Characterization Summary will be submitted to EPA and CDH for review This summary will provide an early description of the initial site characterization effort, including a preliminary presentation of analytical data and a listing of chemical and radiological contaminants, the affected media, and potential sitewide chemical-specific ARARs In addition to the characterization summary, technical memoranda will be prepared with the completion of each field sampling task to provide preliminary results of field investigations

TABLE 5.1

GENERAL RESPONSE ACTIONS, TYPICAL ASSOCIATED REMEDIAL TECHNOLOGIES, AND EVALUATION

General Response Action	Description	Typical General Response Technologies	Action to Potential Pathways
No Action	No remedial action taken at site	Some monitoring and analyses may be performed	National Contingency Plan requires consideration of no action as an alternative Would not address potential pathways, although existing access restriction would continue to control on-site contact.
Access and use restrictions	Permanent prevention of entry into contaminated area of site Control of land use	Site security, fencing, deed use restrictions, warning signs	Could control on-site exposure and reduce potential for off-site exposure. Some site security fencing and signs are in place. Additional short-term or long-term access restrictions would likely be part of most remedial actions
Containment	In-place actions taken to prevent migration of contaminants.	Capping, ground water containment barriers, soil stabilization, enhanced vegetation.	If applied to source, could be used to control all pathways If applied to transport media, could be used to mitigate past releases (except air)
Pumping	Transfer of accumulated subsurface or surface contaminated water, usually to treatment and disposal	Ground water pumping, liquid removal from surface impoundments	Applicable removal of contaminated ground water and bulk liquids (for example, from tanks, pipes, or drums)
Removal	Excavation and transport of primarily nonaqueous contaminated material from area of concern to treatment or disposal area.	Excavation and transfer of soils, contaminated structures	If applied to source, could be used to control all pathways If applied to transport media, will control corresponding pathway Must be used with treatment or disposal response actions to be effective

TABLE 5.1

GENERAL RESPONSE ACTIONS, TYPICAL ASSOCIATED REMEDIAL TECHNOLOGIES, AND EVALUATION (Continued)

General Response Action	Description	Typical General Response Technologies	Action to Potential Pathways
Treatment	Application of technology to change the physical or chemical characteristics of the contaminated material Applied to material that has been removed	Solidification, biological, chemical, and physical treatment	Applied to removed source material, could be used to control all pathways Applied to removed transport media, could control air, surface water, ground water, and sediment pathways
In-Situ Treatment	Application of technologies in-situ to change the in-place physical or chemical characteristics of contaminated material	In-situ vitrification, bio-remediation.	Applied to source, could be used to control all pathways Applied to transport media, could be used to control corresponding pathways
Storage	Temporary stockpiling of removed material in a storage area or facility prior to treatment or disposal	Temporary storage structures	May be useful as a means to implement removal actions, but definitely would not be considered a final action for pathways
Disposal	Final placement of removed contaminated material or treatment residue in a permanent storage facility	Permitted landfill, repositories	With source removal, could be used to control all pathways With removal of contaminated transport medial, could be used to control corresponding pathway (except air)
Monitoring	Short-and/or long-term monitoring is implemented to assess site conditions and contamination levels	Sediment, soil, surface water, and ground water sampling and analysis	RCRA requires post-closure monitoring to assess performance of closure and corrective action implementation

TABLE 5.2

RESPONSE ACTIONS, REMEDIAL TECHNOLOGIES, AND DATA REQUIREMENTS

General Response Actions	Associated Remedial Technologies	Data Purpose	Data Need
Complete or partial removal and treatment of contaminated soils	• Disposal (off-site)	Evaluate RCRA land ban and radioactivity restrictions	- 40 CFR 268 Table CCWE and Appendix III Analyses - Full suite of radionuclide analyses
		Cost analysis	- Vertical and horizontal extent of contamination
In-situ contaminated soils treatment	• Immobilization	Determine viscosity of grout material	- Soil grain size distribution (sieve analysis)
		Effectiveness	- Full suite of organic and inorganic analyses
	• Soil flushing	Effectiveness	- Full suite of organic and inorganic analyses - Soil organic matter content - Soil classification - Soil permeability - Treatability study
	• Vapor extraction	Effectiveness	- Full suite of organic and inorganic analyses - Subsurface geological characteristics - Depth to ground water - Soil permeability - Treatability
	• Vitrification	Cost effectiveness	- Full suite of organic and inorganic analyses - Treatability study

TABLE 5.2

RESPONSE ACTIONS, REMEDIAL TECHNOLOGIES, AND DATA REQUIREMENTS
(Continued)

General Response Actions	Associated Remedial Technologies	Data Purpose	Data Need
Ground water collection	• Well array/subsurface drains	Storativity (transient flow)	- Aquifer tests
Infiltration and ground water containment controls	• Capping/subsurface barriers	Suitability of off-site soil for use	- Gradation (sieve analysis) - Atterberg limits (plasticity tests) - Percent moisture - Compaction (proctor) - Permeability (triaxial permeability) - Strength (triaxial or direct shear)
		Effectiveness	- Location of subcropping sandstones - Hydraulic conductivity of bedrock materials
		Construction feasibility	- Grade - Depth to bedrock
In-situ ground water treatment/immobilization	• Immobilization	Determine viscosity of grout material	- Soil grain size distribution (sieve analysis)
		Effectiveness	- Full suite of organic and inorganic analyses
	• Aeration	Effectiveness	- Full suite of organic and inorganic analyses - Subsurface geological characteristics - Depth to ground water - Soil permeability - Treatability study

TABLE 5.2

RESPONSE ACTIONS, REMEDIAL TECHNOLOGIES, AND DATA REQUIREMENTS
(Continued)

General Response Actions	Associated Remedial Technologies	Data Purpose	Data Need
Ground water/surface water treatment	• UV/peroxide or UV/ozone	Process control	- Iron and manganese
		Effectiveness	- Full suite of organic and inorganic analyses - Treatability study
	• Air stripping	Process control	- Hardness
		Effectiveness	- Full suite of organic and inorganic analyses - Treatability study
	• Other water treatment technologies (carbon adsorption, ion exchange, electrodialysis, and reverse osmosis)	Process control	- Full suite of organic and inorganic analyses - Treatability study
		Effectiveness	

Approved By.

______________________ __/__/__
Work Plan Manager (Date)

______________________ __/__/__
Division Manager (Date)

Effective Date. ______________________

7.0 FIELD SAMPLING PLAN

The purpose of this section is to provide a Field Sampling Plan (FSP) that will generate sufficient and adequate data to satisfy the Phase I RFI/RI objectives developed in Section 4.0. These site-specific objectives are presented in Section 7 1 Current site conditions and a discussion of the rationale for the sampling and analysis activities needed to obtain the necessary data to meet the Phase I objectives are summarized in Section 7 2

7 1 OBJECTIVES

As stipulated in the IAG, the purpose of the Phase I RFI/RI field investigation is to characterize the contaminant sources and the soils within the OU For the Phase I investigation, characterization of soils (i e , surficial deposits) will be limited primarily to the vadose zone. Therefore, the scope of this FSP is to characterize any remaining inventory in the OPWL system and characterize the nature and extent of contamination in vadose zone soils In addition, the field investigation will confirm the location and current status of OPWL components, particularly the underground pipelines

Tanks and pipelines which are active waste management units are not included in the scope of this Work Plan because their structures and associated soils will be addressed at the time of their closure in accordance with the RCRA Part B Permit Applications for the Rocky Flats Plant (DOE, 1986b, DOE, 1987) Some abandoned pipelines and tanks beneath buildings cannot practically be investigated at this time due to the nature of the RFP and the potential for disruption of operations.

In these cases, the existing building roofs and floors provide capping and covering on an interim basis and the RCRA ground water assessment program will monitor for releases. Partially accessible pipelines and tanks beneath buildings which are not active waste management units will be investigated to the extent possible

7 2 BACKGROUND AND RATIONALE

Previous investigations performed at OU9 and other pertinent background information are discussed in Section 2.0. As mentioned in Section 4 1 2, no known effort has been made to validate any of the data from investigations of OU9 Therefore, this FSP has been developed under the assumption that no usable data is available to describe contaminant sources and soils in the vadose zone of OU9 Historical information obtained through additional data compilation activities (Section 7 2.4) will be used to help focus the FSP on known or suspected release locations and contaminants as described in the following sections Table 7 1 describes several technical memoranda that will be submitted during the OU9 Phase I RFI/RI to document results from the various stages of the investigation and to propose specific activities for subsequent stages based on these results.

7 2 1 Sampling Rationale

The rationale for the Phase I sampling activities at OU9 is based on a staged approach Due to the lack of available data and the large expanse of OU9, sampling activities will be performed in a multiple stage approach Pipeline investigation will be conducted using a three-stage approach Tank investigation will be conducted using a two-stage approach

Stage 1 sampling activities are designed to detect points of contamination in OU9 vadose zone soils and to provide an assessment of the nature of contamination at these locations. Using the release scenarios developed in the conceptual model (Section 2 5) and additional information provided by data compilation activities (Section 7 2 4), sampling locations will be selected for investigation which represent the most probable sites of contamination Stage 1 pipeline investigation involves excavation of a series of test pits along the pipeline alignments Samples of any remaining pipeline inventory, trench backfill materials, and native soils will be collected from each test pit In addition, a groundwater grab sample will be collected from test pits where groundwater is encountered. Stage 1 tank investigation involves drilling of borings around tank locations Soil samples will be collected by continuous core auger method Where vadose zone bedrock is encountered in borings, a bedrock sample will be collected at the bedrock/alluvium contact to provide a preliminary assessment of contaminant migration into bedrock. Any remaining inventory in the tanks also will be sampled. The analytical results of Stage 1 sampling will provide an assessment of the nature of contamination present in OU9 vadose zone soils and may provide preliminary information on groundwater contamination

Stage 2 sampling activities are designed to provide an assessment of the extent of contamination present in OU9 vadose zone soils. Locations of contamination identified by analytical results from Stage 1 sampling will be further investigated to delineate the extent of contamination in vadose zone soils The Stage 2 pipeline investigation will partially assess the extent of contamination present in vadose zone soils along OPWL pipeline alignments Samples of trench fill material and native soils beneath the trenches will be collected from borings completed at regular intervals between Stage 1 test pit locations The Stage 2 tank investigation will determine the horizontal and vertical extent of contamination present in vadose zone soils surrounding OPWL tanks Samples of native soil and vadose-zone bedrock will be collected from borings drilled on a pattern determined on a case-by-case basis for each tank location The sampling pattern will be expanded as necessary to fully delineate the extent of vadose zone soil contamination around each tank location. Stage 2 borings will be drilled and sampled using the continuous core auger method

Stage 3 sampling activities will be conducted for the pipeline investigation only. The need for the Stage 3 investigation will be decided on a case-by-case basis for each pipeline release location identified during the Stage 1 and Stage 2 investigations Stage 3 will be designed to assess the horizontal and vertical extent of contamination in vadose zone soils surrounding OPWL pipelines. Areas of contamination along pipeline alignments identified by analytical results from Stages 1 and 2 will be further investigated to fully delineate the extent of contamination in vadose zone soils Samples of native soil adjacent to the pipeline trench will be collected from borings drilled on a pattern determined on a case-by-case basis for each area of contamination. Additional borings may also be drilled along the pipeline alignments to fully delineate the extent of contamination in trench fill material and native soils underlying the trench Stage 3 borings will be drilled and sampled using the continuous core auger method

In accordance with the IAG, all decisions regarding sampling locations (i.e., location of test pits and borings) and the need for further investigation at individual sites will be documented by submitting technical memoranda (Table 7 1).

7 2 2 Analytical Rationale

The analytical parameters for OU9 Stage 1 sampling activities are listed in Table 7 2. This analyte list has been developed during the preparation of field sampling plans for other RFP OUs similar to OU9 in that their operational history or release history is not clearly defined. This list is intended to apply to all OUs for which potential contaminants cannot reliably be identified based on operational history At this time, information on the operational history of OU9 is incomplete, and the listing provided in Table 7 2 will be the primary index of analytical parameters The only exception taken for OU9 to the standardized Phase I RFI/RI list is analysis for pesticides and PCBs Existing information provides no reasonable indication that these contaminants were ever discharged to the OPWL As explained below, pesticides and PCBs, along with other potential contaminants, may be added to the analyte list based on the results of additional data compilation activities

The detection/quantitation limits shown in Table 7 2 are CLP quantitation limits specified for soil and water matrices in GRRASP (EG&G, 1991e) Detection/quantitation limits for residue matrix (i e , waste or sludge) are not specified in GRRASP Due to the nature of residue matrices, detection/quantitation limits will be the minimum obtainable for a given matrix

The OU9 Stage 1 analytical parameter list may be modified for some areas of the OPWL. Known waste streams associated with OPWL operation are summarized in Table 2.6 Additional data compilation activities (Section 7 2 4) may confirm and expand this information to a degree which would eliminate certain analytical parameters from consideration in a given area of OU9 Likewise, this information may identify additional compounds discharged to the OPWL which necessitate additional analytical parameters in a given area of OU9 These determinations will be made on a case-by-case basis. In accordance with the IAG, any decision made regarding modification of the analyte list presented in Table 7.2 will be documented by submitting technical memoranda (Table 7 1)

Analytical results from Stage 1 samples will dictate the analytical parameters for Stage 2 samples. Utilization of the analytical parameter list presented in Table 7 2 for Stage 1 samples, and modified as appropriate based on additional data compilation activities, will provide maximum potential for identifying all potential contaminants in OU9 vadose zone soils Stage 2 analytical parameters will then focus on those contaminants identified by Stage 1 analytical results Analytes of concern will be selected based on concentration levels exceeding values identified for alluvium and bedrock by the Final Background Geochemical Characterization Report (EG&G, 1991d) and potential ARARs. Again, decisions regarding analytical parameter selection will be documented by submitting technical memoranda

7 2.3 Relevant Studies of Other OUs

Current and planned investigations at other OUs may provide data relevant to the Phase I investigation of OU9 Possible interactions with other OUs were discussed in Section 2.2 4 Although areas of overlap with other OUs do not imply a reduction in scope of the Phase I investigation of OU9, such overlaps should be examined to prevent duplication of effort Provided that the specified objectives of the OU9 Phase I RFI/RI are achieved, data from studies of other OUs may be utilized to supplement or replace sampling activities in OU9 These determinations will be made on a case-by-case basis Decisions regarding use of data from studies of other OUs will be documented by submitting technical memoranda

7 2 4 Additional Data Compilation

It was originally intended that the OPWL Closure Plan (DOE, 1986b, DOE, 1988) would provide all information necessary to characterize the OPWL for purposes of this Work Plan However, it became apparent during preparation of the Work Plan that the Closure Plan does not contain sufficient information to plan a detailed investigation of the OPWL Additional sources of information are known or believed to exist which will aid in understanding the OPWL and in scoping the field investigation of the unit As such, additional data compilation activities will be necessary prior to implementing the FSP provided in this section. The intent of these activities is to assemble and review all available information on the OPWL to better focus subsequent sampling activities in the OU9 field investigation

Because much of the OPWL was placed in service when RFP began operations in 1952, it is expected that engineering records and employee knowledge will not provide detailed information on many of the underground OPWL pipelines, and that test pit excavation (Section 7.3.1.1) will be necessary to delineate these pipelines The additional data compilation will therefore be ongoing throughout the Stage 1 pipeline investigation as test pits provide new information about OPWL pipeline characteristics

7 2 4 1 Objectives

A summary of current information available on the OPWL is presented in Appendix B. This appendix includes data from the Closure Plan as well as additional data compiled during preparation of the Work Plan to more clearly define the history and status of OPWL tanks As such, the primary focus of the additional data compilation will be to more clearly define the history and status of the OPWL pipelines It is intended that data compilation and field investigation activities be used to constantly update the data summary sheets in Appendix B These data summary sheets will therefore provide the most current reference possible to direct field sampling activities

The specific objectives of the additional data compilation activities and their use in focusing the investigation of OU9 are as follows

- Identify any OPWL pipelines and tanks that were not identified in the OPWL Closure Plan. This will help delineate the scope of the OU9 RFI/RI. Existing information suggests that some pipelines and tanks associated with OPWL were not identified in the Closure Plan

- Identify OPWL pipelines and tanks which have been converted to the new process waste system These pipelines and tanks will be addressed under their respective RCRA permits rather than the OU9 RFI/RI

- Identify areas of soil disruption around OPWL pipelines and tanks. This would include construction activities such as installation of new utilities in OPWL trenches, paving, or any other trenching or excavation proximal to OPWL components. Damage to OPWL components and potential changes to the hydraulic conductivity of the disturbed soils will be evaluated to focus the field investigation. In addition, results from any radiation surveys or sample analyses performed in conjunction with construction projects will be obtained if possible to help identify historical release areas

- Identify OPWL pipelines and tanks that have been modified, repaired, replaced, or removed This will help delineate pipeline segments not conducive to pressure testing as well as help focus the Stage 1 sampling locations Results from any radiation surveys or sample analyses performed in conjunction with these projects will be obtained if possible to help identify historical release areas

- Identify historical OPWL discharge points. This will clarify OPWL operation and process waste flow Existing information suggests certain waste streams were transported directly to the Solar Evaporation Ponds, Pond B-2, or other locations without treatment at the process waste treatment facility in Building 774

- Determine waste flow direction in individual OPWL pipeline sections. This will clarify OPWL operation and process waste flow Evaluation of all waste streams handled in a particular pipeline or tank may support component-specific or area-specific modifications to the Stage 1 analytical parameter list (Table 7.2)

- Identify OPWL pipelines which were pumped (forced-flow) lines. This will clarify OPWL operation and process waste flow, and may indicate lines which were more susceptible to leakage due to higher operating pressures Existing information suggests that some portions of the OPWL would require lift stations and/or forced flow to reach Building 774

- Locate OPWL pipeline structural features (e g , valves, valve vaults, pumps, lift stations, manholes, elbows, tees, etc) Structural features will be primary sampling locations for the Stage 1 pipeline investigation

- Identify known OPWL release sites Known release sites will be primary sampling locations for the Stage 1 pipeline and tank investigations

- Improve OPWL waste stream characterization Review of pre-shipment waste characterization analyses will provide an indication of potential contaminants associated with particular OPWL components Waste stream characterization together with OPWL operation and process waste flow information may support component-specific or area-specific modifications to the Stage 1 analytical parameter list (Table 7 2)

- Determine exact dates of operation for OPWL pipelines and tanks. This will better define OPWL operational history

- Evaluate potential logistical problems associated with field investigation activities. This will identify areas where modification of the FSP may be required due to physical access restrictions, security restrictions, interference with RFP operations, or other unforeseen difficulties

- Evaluate the feasibility of partial investigation of OPWL pipelines and tanks located beneath buildings This evaluation will consider the following factors:

  - Building status (active or inactive) and function

  - Proximity of pipeline or tank to edge of building

  - Depth of pipeline or tank

  - Known or suspected releases from pipeline or tank beneath building

  - Potential cross-contamination from other sub-building sources, including building footing drains

  - Logistical considerations, including physical or security access restrictions and the potential for disruption of building operations

7 2 4 2 <u>Activities</u>

The following additional data compilation activities will be conducted to meet the specific objectives outlined in the preceding section The information gathered during each of these activities will be documented, combined with results from other activities, and reviewed to better focus subsequent field investigation activities (see Section 7 2 4 3)

<u>Site Walk</u>

In order to provide a tactical assessment of the OPWL, a site walk of the unit will be conducted Visual inspections of the OPWL will assist in identifying

- OPWL component locations and interconnections
- Location of structural features (valves, cleanouts, manholes, etc)
- Location of pipeline penetrations into buildings
- Areas where construction activities may have disturbed OPWL components
- Logistics problems associated field sampling activities (e.g., security requirements, heavy equipment access restrictions, etc.)

Interviews

Additional information on the OPWL will be assembled by conducting interviews with knowledgeable RFP contractor and subcontractor employees In particular, individuals involved in RFP waste treatment and disposal and in the preparation of the Closure Plan will be targeted.

Records Review

RFP historical records will be reviewed to provide information helpful to the OPWL investigation. Potential sources of these records are

- Closure Plan field notes and reference documents
- RFP files held at the Denver Federal Center
- EG&G Facilities Engineering drawings
- RFP construction project files
- Waste transfer records held in production buildings

Information helpful in identifying areas of contamination in OU9 has been compiled on a database under the RFP HRR effort Relevant information will be obtained by searching the HRR database for OPWL references Reports documenting releases from the OPWL will be reviewed to identify release locations to be targeted in subsequent sampling activities In some instances, exact release locations will not be discernable, rather, a segment of the OPWL will be identified as an area of suspected release These locations and areas will then be designated as primary sampling locations in the field investigation

7.2 4 3 Application

Upon completion of the additional data compilation activities, the newly gathered information will be reviewed and evaluated. The results of this evaluation may mandate comprehensive or specific modifications to the FSP Changes to the FSP may include, but not be limited to, the following:

- Stage 1 analytical parameter list (Table 7 2)
- Number of pipelines and/or tanks to be investigated under the OU9 Phase I RFI/RI
- Number and location of test pits for the Stage 1 pipeline investigation.

The results of the additional data compilation activities and any proposed modifications to the FSP will be submitted in technical memorandum TM1 (Table 7 1) for review and approval

7 2 5 Surface Radiation Surveys

Existing information on OPWL releases indicates that released wastes impacted surface soils at some locations Examples include tank overflows, flooding and overflow of valve vaults, and leakage from underground pipelines which may have been forced-flow (i e., pumped) lines. In addition, some OPWL pipelines may have been aboveground (e g , pipeline P-40 between the 900 Area and Pond B-2)

Locations where surface soils may have been directly impacted by OPWL releases will be identified to the extent possible during additional data compilation activities (Section 7.2.4). Surface radiation surveys will then be conducted at these locations using a high-purity germanium detector to assess the potential for remaining radioactive contamination in surface soils The area to be surveyed and the configuration of the survey pattern will be developed on a case-by-case basis using all available historical information on the particular location Factors to be considered include:

- Nature of the released radionuclides (activity levels, isotopic composition, environmental fate and mobility, etc)
- Date (age) of the release
- Volume of release
- Surface configuration of release area to determine possible flow paths
- Pavement or other surface cover, including pavement placed subsequent to release
- Historical surface radiation surveys of the area
- Cleanup activities subsequent to the release

The surface radiation surveys will be conducted in accordance with OP FO 16, Field Radiological Measurements, and additional surface radiation survey OPs currently under development by EG&G.

7 3 SAMPLING DESIGN AND LOCATIONS

The Phase I RFI/RI investigation activities at OU9 are discussed below. These activities are also summarized in Table 7 3

7 3 1 Pipeline Investigation

The sampling design and locations for the OPWL pipeline investigation are discussed below. Pipeline sampling will be conducted using a three-stage approach This section details activities to be conducted during each of the three stages of the pipeline investigations

Tentative Stage 1 pipeline test pit locations are indicated in Figure 7-1 It must be emphasized that this represents only Stage 1 test pit locations at pipeline endpoints and known structural features As specified by the pipeline release conceptual model (Section 2 5 2 1), the maximum test pit spacing along pipeline alignments is 200 feet. Information derived from additional data compilation activities (Section 7 2 4), field observations, surface radiation surveys, and analytical results from previous stages of the investigation will dictate the specific sampling intervals required. These results will be summarized in technical memorandum TM1 (Table 7 1) The decision process for identification of sampling locations is discussed below

7 3.1 1 Stage 1 Investigation

As discussed in Section 7 2 1, the Stage 1 investigation is designed to locate areas of contamination in OU9 vadose zone soils, based on conceptual model release scenarios (Section 2.5.2) and information derived from additional data compilation activities (Section 7.2 4), and to provide an assessment of the nature of contamination at these locations Pipelines will be investigated by excavating a series of test pits along pipeline alignments These test pits will provide the following:

- Confirmation of pipeline location and configuration
- Visual inspections of pipeline integrity
- Samples of surface soils
- Samples of pipeline trench backfill
- Samples of native soils beneath the pipeline trench
- Samples of any residue in pipelines
- Samples of any groundwater encountered in test pits

The Stage 1 pipeline investigation will be conducted in accordance with all applicable EMD OPs Activities will be governed by OPs as follows

- Prework radiation survey of test pit locations will conducted according to OP FO.16, Field Radiological Measurements.
- Prior to excavation, test pit locations will be cleared according to OP GT 10, Borehole Clearing
- Surface soil samples will be collected using the grab sampling method per OP GT 8, Surface Soil Sampling
- Test pits will be excavated and sampled in according to OP GT.7, Logging and Sampling of Test Pits and Trenches

- Groundwater encountered in test pits will be sampled in accordance with OP SW.3, Surface Water Sampling
- Field parameters will be measured on test pit groundwater samples in accordance with OP SW.2, Field Measurements of Surface Water Field Parameters.
- Residue sampling in pipelines will be performed according to the OP revision presented in Section 11 0
- Wastes generated during the excavation of test pits and pipeline opening and sampling will be handled in accordance with OP FO 8, Handling of Drilling Fluids and Cuttings.
- Test pit locations will be surveyed to achieve final location and elevation accuracies of ±0 1 feet per OP GT 17, Land Surveying

Location of Test Pits

The pipeline test pit location decision tree is presented in Figure 7-2 As discussed in the pipeline release conceptual model (Section 2 5 2 1), pipeline releases are most likely to occur at structural features in the pipeline Structural features will be identified as primary test pit locations. Examples of structural features include

- Valves, cleanouts, manholes, and other pipeline openings
- Elbows, tees, and reducers
- Pipe/tank connections
- Transitions in pipeline materials

Known or suspected release locations identified during the additional data compilation activities (Section 7 2 4) will also be targeted as primary test pit locations, as will any "hot spots" identified through the surface radiation surveys

Per the pipeline release conceptual model, the maximum spacing between test pits is 200 feet However, certain conditions may exist which mandate closer test pit spacing Test pit spacing will be reduced to a maximum 100 feet under the following conditions

- Historical information indicates that a release occurred along a particular section of pipeline, but the exact location of the release cannot be determined from the available information

- Poor pipeline integrity is observed in a test pit

- Poor pipeline integrity is observed in pipeline video inspection (see discussion below under Pipeline Video Inspection)

- Pipeline pressure testing results indicate pipeline leakage (see discussion below under Pipeline Pressure Testing)

- Along removed pipeline alignments (see discussion below under Removed Pipelines).

The rationale for the reduction to 100 foot test pit spacing is to double the sampling density in areas of uncertain conditions This will increase the probability of identifying areas of contamination along the pipelines

Surface Soil Sampling

A surface soil sample will be collected from each test pit location prior to excavation of the test pit The sample location will be as close as possible to the center of the area to be excavated Surface soil samples will be collected in accordance with the grab sample method described in OP GT 8, Surface Soil Sampling. The grab method is more applicable to collecting a discrete sample at a single location consisting of a small area This is most appropriate for the OU9 investigation where one objective is to determine if contamination was deposited from an aqueous solution Overlying pavement or other surface cover will be removed if necessary Each surface soil sample will consist of a six inch square area sampled to a depth of six inches (i e , a sample of dimensions six by six by six inches) This will provide sufficient sample volume to perform the analyses specified in Section 7 4

Test Pit Excavation Procedures

Test pits will be excavated in accordance with the applicable provisions of OP GT 7, Logging and Sampling of Test Pits and Trenches Test pit excavation will commence after collection of a surface soil sample at the test pit location, and after removal of any pavement or other surface cover as necessary Pipelines must be exposed in their in-situ condition so that unbiased assessment of pipeline integrity can be made Test pit construction will therefore be performed in a manner that does not damage the in-situ conditions of the pipelines Mechanized digging equipment (e.g , backhoes) will be used to remove only the bulk of material covering the pipeline. Periodic manual probing may be necessary to measure the depth of the remaining cover Once a depth of cover less than one foot remains, test pit excavation will be completed with shovels Information gathered to complete excavation permitting procedures, described in OP GT 10, will help in planning the excavation by identifying potential interferences (e g , nearby underground utilities).

Test Pit Logging and Sampling

Test pit logging and sampling will be conducted in accordance with OP GT.7, Logging and Sampling of Test Pits and Trenches At each test pit, the condition of the exposed pipe material will be described and documented Evidence of pipeline dδegradation (e g , excessive corrosion, holes, cracks) will be described in detail The pipeline and test pit will be photographed and sketched in accordance with OP GT 7 The location and invert elevation of the pipe will be surveyed Soils exposed in the excavations will be described for visible contamination, extent of trench backfill, and the type of backfill material

Nominal Stage 1 soil sample locations are illustrated in Figure 7-3 One discrete soil sample will be collected at each of the following locations

- Ground surface (prior to excavation)
- In trench backfill directly beneath the pipeline
- In native soil directly below trench

After collection of soil samples, one sample of pipeline residue will be collected at every test pit where feasible to characterize OPWL wastes In instances where no residue is present, one wipe sample will be taken on the interior surfaces of pipeline components Wipe samples will be collected and tested according to OP FO.16, Field Radiological Measurements This will provide a qualitative measure of radionuclide contamination In addition, inside surface radiological dose rate measurements will be obtained by inserting a low energy gamma probe radiation detector into the pipeline These measurements will be useful in verifying process piping historical data and allow for future disposal criteria Valves, cleanouts, manholes, and other pipeline openings will be the preferred locations for collection of residue samples Where other access is not available, the pipe will either be cut open or dismantled at test pit exposures (see Section 11.0). Pipe sections which are dismantled will be reassembled if possible Pipe sections which are cut or which cannot be reassembled will be grouted closed with a plug of non-shrinking cement

If groundwater is encountered in a test pit, a groundwater grab sample will be collected in accordance with OP SW 3, Surface Water Sampling, and submitted for analysis Field parameters will be measured on the groundwater sample as discussed in Section 7 4 2 No attempt will be made to open pipelines and collect residue samples The trench backfill directly below the pipeline will be sampled if possible, but the native soil directly beneath the trench will not be sampled (see Figure 7-3) The depth at which ground water is encountered will be recorded

Pipeline Location and Tracing

In general, it is expected that pipeline structural features will allow pipeline alignments to be traced sufficiently to locate test pits along the alignment Where structural features are absent or widely spaced, however, pipeline location devices may be utilized to trace the pipelines The method used will depend upon the pipe construction material Conductive pipes can be readily located by attaching a transmitter to the outer surface of the pipe This produces a signal along the buried pipeline which can be traced by a detector at the surface For nonconductive pipes, a flexible steel tape or similar conductive material must be inserted into an opening in the pipe and fed down the pipeline to carry the signal Alternatively, a transmitting sonde can be inserted and moved down the pipeline with push rods or a steel tape Pipeline video inspection (see discussion below) can also be utilized to trace pipeline alignments by providing azimuth and range data Ground-penetrating radar (GPR) may provide another method of tracing pipelines, although its efficacy may be limited by the clayey, cobble-rich soil of the site and by congestion of pipelines and utility lines at many locations

Pipeline location and tracing methods will be field-tested if it appears that pipeline tracing will be necessary to the Stage 1 pipeline investigation. Specific procedures for performing pipeline location and tracing will be provided by the contractor(s) selected to provide the service. These procedures will be modified as necessary to support the objectives of the OU9 RFI/RI and conform with project-specific health and safety or environmental protection requirements

Pipeline Pressure Testing

Although the pipeline investigation has been designed to target both known release locations and locations most susceptible to releases, only a small percentage of the total pipeline system will be excavated and inspected In order to more fully evaluate the current status of the pipeline system, pressure testing will be performed where possible on pipeline segments between available access points (test pits, manholes, valve vaults, etc) Pressure testing will not be performed where potential access points are below the water table

Pipeline pressure testing may aid in detecting release locations in unexcavated portions of pipelines, and in confirming the integrity of pipelines that appear sound in test pits Where successfully performed, the testing will provide an additional measure of assurance that sections of pipeline which are not visually inspected have been evaluated Pressure testing results together with historical data may provide sufficient justification to remove a particular pipeline section from further investigation and, more importantly, from having to be addressed by a final remedial action for OU9

It is expected that pipeline pressure testing will have limited application at OU9 Because historical data for many of the pipelines are incomplete, conclusions based on the testing results will have to take into account the uncertainty of a particular pipeline's operating history. The following specific factors will affect the applicability of pipeline pressure testing and the interpretation of the results

- Pipeline materials (e g , vitrified clay pipe) and diameter may not be conducive to pressure testing

- Many pipelines transferred waste through gravity flow and therefore had very low operating pressures. Pressure testing should be designed to approximate the operating pressures of the pipelines to the extent possible

- The majority of the pipelines have been inactive for 15 to 20 years or more Any leaks detected in the pipelines may have developed after the pipelines were removed from service

- Contamination may exist at locations where pipeline leaks were excavated and repaired Contamination may also exist at locations where a replacement pipeline was installed in the same alignment where an older, leaking pipeline was removed. Pipelines which currently test "tight" may have been repaired, or may be a replacement line for an older pipeline which leaked Historical data may help identify locations of pipeline repair and replacement However, it is expected that maintenance and construction records for the pipelines will be incomplete, particularly for the early operating history of RFP (1950s and 1960s)

Techniques using tracer gas (typically helium) or sensors to detect air motion around leaks can be employed during pressure testing to identify specific leak locations along pipelines

Because the OPWL pipelines vary widely in age, diameter, material of construction, and operating history, pipeline pressure testing will be field-tested under a variety of conditions in order to evaluate its feasibility and potential benefits to the Stage 1 pipeline investigation. Specific procedures for conducting the pressure testing will be provided by the contractor(s) selected to perform the testing. These procedures will be modified as necessary to support the objectives of the OU9 RFI/RI and conform with project-specific health and safety or environmental protection requirements.

Pipeline Video Inspection

Video inspection of pipeline interiors may be beneficial in evaluating the integrity of the pipeline and in tracing pipeline alignments In particular, video inspection may aid in evaluating leaks detected through pipeline pressure testing, and aid in evaluating pipelines which are not conducive to pressure testing (e g , vitrified clay pipelines) Video inspection can be performed on pipelines as small as three inches in diameter

The potential applicability and benefits of pipeline video inspection depend upon the same factors that are identified above for pipeline pressure testing. Pipeline video inspection will be field-tested in order to evaluate its feasibility and potential benefits to the Stage 1 pipeline investigation. As with pipeline pressure testing, specific procedures for conducting video inspections will be provided by the contractor(s) selected to provide the service These procedures will be modified as necessary to support the objectives of the OU9 RFI/RI and conform with project-specific health and safety or environmental protection requirements.

Removed Pipelines

Some OPWL pipelines are known to have been physically removed after being taken out of service Existing information indicates that sections of pipelines have been removed during construction of new buildings Pipelines known to have been removed are identified in the OPWL Data Summary Sheets (Appendix B) and are highlighted on the OPWL Location Map (Figure 2-2) Additional data compilation activities may identify other removed pipelines or sections of pipelines.

The alignments of all removed pipelines will be identified and located to the extent possible using historical information, which may include engineering drawings and construction records documenting the removal of the pipeline If the general location of the alignment is known, it may be possible to locate remnant trench fill materials (particularly sand or gravel bedding) through excavation of test pits GPR may also be helpful in locating the alignments (see Pipeline Location and Tracing section above).

As shown in Figures 7-2 and 7-3, Stage 1 investigation of removed pipeline alignments will follow a similar decision process as that for existing pipelines If test pits are used to trace the alignment, soil samples will be collected in the same manner and locations as existing pipeline alignments Where test pits are not used to trace the alignment, borings will be drilled, using a hand auger if possible or a drilling rig if necessary, to collect soil samples from the bottom of the trench and native soil directly below the trench A combination of test pits and borings may be appropriate for some alignments. The test pits and/or borings will be located using the same criteria as for location of test pits along existing pipelines, i e , they will target known release locations and structural features to the extent possible The spacing between test pits and/or borings along removed pipeline alignments will not exceed 100 feet Areas of the removed pipeline alignments found to be contaminated in the Stage 1 investigation will be investigated further under Stages 2 and 3 in the same manner as existing pipeline alignments

Pipeline Valve Vaults

As described in Section 2 2 2 2, valve vaults were constructed at a number of pipeline intersections to facilitate access and inspection of pipelines and valves These concrete structures typically were built below grade, and served as secondary containment in the event of a leak at the pipeline junction or valve OPWL valve vaults are shown on the site utility location maps in Appendix A. Existing information indicates that OPWL valve vaults were flooded by released waste in a number of instances The original Valve Vault No 7 location immediately west of Building 707 is targeted by IHSS 123 1 (see Table 2 4 and Section 2 2 4) as a result of historical releases. Specific information regarding the location and historical operations of OPWL valve vaults will be obtained during additional data compilation activities (Section 7 2 4)

Because they are very similar in configuration and operational history to secondary containment structures housing OPWL tanks ("process waste pits," see Section 2 2 3 and Appendix B), OPWL valve vaults will be incorporated into the OPWL tank investigation described in Section 7 3 2 Valve vaults may provide access to pipelines for purposes of pressure testing, residue sampling, video inspection, and insertion of locator devices, as described previously in this section

7 3.1 2 Stage 2 Investigation

As discussed in Section 7 2 1, the Stage 2 pipeline investigation will target contaminated sites identified during the Stage 1 investigation The Stage 2 investigation is designed to provide a reasonable preliminary assessment of the extent of vadose zone soils contamination along pipeline alignments Per the pipeline release conceptual model (Section 2 5.2.1), the initial spread of contamination from pipeline releases is expected to be preferentially aligned along the pipeline. It is also expected that contaminant movement into native soils surrounding the pipeline trench will occur primarily from the bottom of the trench Therefore, Stage 2 borings will be drilled along the pipeline alignments and will sample both trench fill material and native soil underlying the trench Where vadose zone bedrock is encountered in borings, a bedrock sample will be collected at the bedrock/alluvium contact to provide a preliminary assessment of contaminant migration into bedrock The spacing of borings along the alignment is meant to help differentiate areally restricted, lower-volume releases from potentially more significant higher-volume releases The following discussion outlines the methods and procedures which will be employed during Stage 2.

Pipeline alignments adjacent to test pits (and/or borings for removed pipelines) identified as contaminated by Stage 1 analytical results will be sampled by borings drilled in a nominal pattern around the test pits, as illustrated in Figure 7-4. Specific locations to be investigated will be proposed in technical memorandum TM2 (Table 7 1) Where a contaminated test pit occurs between two clean test pits, borings will be drilled at 5 and 20 foot intervals along the alignment in both directions from the contaminated pit Where two or more consecutive contaminated test pits occur, borings will be drilled at 20 foot intervals along the alignment between the test pits, and at 5 and 20 foot intervals along the alignment outside of the contaminated test pit locations Where drilling rig access is restricted, the borings will be drilled as closely as possible to this nominal pattern It may be possible in such instances to drill the borings with a hand auger, depending upon the depth required Similarly, obstructions along the pipeline alignment (e g , a building or security fence) may require modification of the nominal spacing

Nominal soil sampling depths for the Stage 2 borings are depicted in Figure 7-3. One discrete soil sample will be collected at each of the following locations

- Ground surface (prior to drilling)
- In trench backfill near the bottom of the trench

- In native soil directly below the trench

- In native soil mid-depth between the trench bottom and the water table or bedrock, whichever is encountered first

- In native soil directly above the water table or at the bedrock/alluvium interface, whichever is encountered first

- In bedrock at the bedrock/alluvium contact if groundwater is not encountered above the contact (i e , where the vadose zone extends to the bedrock/alluvium contact)

Surface soil samples will be collected using the grab method described in OP GT.8, Surface Soil Sampling Each surface soil sample will consist of a 6-inch square area sampled to a depth of 6 inches Borings will be drilled and sampled in accordance with OP GT 2, Drilling and Sampling Using Hollow-Stem Auger Techniques, using the continuous core auger method. A three-inch inside diameter sample barrel will be used to collect 2-foot long samples from the borings. A sample volume of 2,250 cubic centimeters (approximately 140 cubic inches) will be required to perform the analyses specified in Section 7.4

Recent water level monitoring data, combined with information from alluvial isopach maps, will be used to predict depths to the water table and to bedrock at the various sampling locations. If the depth between the trench bottom and the water table or bedrock is less than 5 feet, the mid-depth soil sample will be omitted

The Stage 2 pipeline investigation will be conducted in accordance with all applicable EMD OPs Activities will be governed by OPs as follows

- Prework radiation surveys of boring locations will conducted according to OP FO 16, Field Radiological Measurements

- Prior to drilling, boring locations will be cleared according to OP GT 10, Borehole Clearing

- Surface soil samples will be collected using the grab method per OP GT 8, Surface Soil Sampling

- Borings will be drilled and sampled by continuous core auger methods according to OP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques
- Boring samples will be logged according to OP GT 1, Logging of Alluvial and Bedrock Material
- Cuttings and fluid generated during drilling will be handled in accordance with OP FO 8, Handling of Drilling Fluids and Cuttings
- Borings will be plugged and abandoned per OP GT 5, Plugging and Abandonment of Boreholes
- Boring locations will be surveyed to achieve final location and elevation accuracies of ±0 1 feet per OP GT.17, Land Surveying

7 3 1 3 Stage 3 Investigation

The Stage 2 pipeline investigation may identify areas which warrant further characterization of vadose zone soils contamination In particular, Stage 2 may indicate areas where contamination affects a significant length of pipeline alignment, suggesting a relatively large release from the pipeline Following the completion of the Stage 2 pipeline investigation, the results of Stages 1 and 2 will be summarized in technical memorandum TM3 (Table 7 1), and the need for additional investigation will be resolved on a site-by-site basis for each contaminated area Where additional investigation is determined to be appropriate, a Stage 3 pipeline investigation will be performed

The Stage 3 investigation will utilize additional borings drilled along the pipeline alignment as necessary to fully determine the extent of contamination in vadose zone soils along the alignment, and in native soil adjacent to the alignment to evaluate any spread of contamination laterally from the pipeline trench into vadose zone soils It is proposed that a reasonable nominal starting point for the Stage 3 investigation is 20 feet along the pipeline alignment beyond the extent of the Stage 2 borings, and five feet laterally from either side of the trench at the location of highest contaminant concentration identified during Stages 1 and 2 The exact boring and sampling locations will be determined on a case-by-case basis, taking into account the following factors

- Environmental fate and mobility of the specific contaminants

- Depth to water table and bedrock at the particular site
- Contaminant concentrations along the pipeline alignment
- Nature of trench fill materials and native soils
- Evidence of significant migration into native soils underlying the trench, as determined through Stage 2 sampling

Proposed Stage 3 boring locations will be documented through technical memoranda which are approved prior to implementation

The procedures described in Section 7 3 1 2 for drilling and sampling Stage 2 borings will also apply to Stage 3 borings

The Stage 3 pipeline investigation is designed to fully assess the lateral and vertical extent of contamination in vadose zone soils affected by pipeline releases It is reasonable to expect that Stage 3 will be implemented in stages in order to meet this objective, with borings located increasingly distant from the contaminant source until the lateral extent of vadose zone soils contamination is delineated As discussed in Section 7 2.2, the extent of contamination will be determined through comparison of analytical results to values provided in the Final Background Geochemical Characterization Report (EG&G, 1991d), or to the most current background data available at the time the FSP is implemented, and to values specified in potential ARARs.

7 3 2 Tank Investigation

The sampling design and locations for the OPWL tank investigation are discussed below This section details the activities to be conducted during the Stage 1 and Stage 2 tank investigations

OPWL tank locations targeted for investigation under the OU9 Phase I RFI/RI are identified in Figure 7-1 Table 7 3 provides the rationale for investigation of each OPWL tank location Only tank locations identified in the OPWL Closure Plan are included in Figure 7-1 and Table 7 3 Additional OPWL tank locations requiring investigation may be identified during additional data compilation activities (Section 7 2 4). These will be addressed as necessary in technical memorandum TM1 (Table 7 1) Also, OPWL pipeline valve vaults (Section 7 3 1 1) will be investigated in the same manner as tank secondary containment structures, or process waste pits, during the OPWL tank investigation The decision process used to identify tank investigation activities and sampling locations is discussed below

7 3 2 1 Stage 1 Investigation

As discussed in Section 7 2 1, the Stage 1 tank investigation is designed to locate areas of contamination in OU9 vadose zone soils, based on the tank release conceptual model (Section 2.5 2) and information derived from additional data compilation activities (Section 7.2 4) and to provide an assessment of the nature of contamination at these locations The following discussion outlines the methods and procedures which will be employed in the Stage 1 tank investigation

The Stage 1 tank investigation will consist of the following activities

- Visual inspections
- Residue sampling
- Borings

The tank investigation decision tree presented in Figure 7-5 specifies how these activities will be applied to specific tank locations As discussed in Section 7 1, tanks which are part of active waste management units will not be investigated Residue samples will not be collected from tanks which have been cleaned and painted since being removed from service Borings will not be drilled for tanks inside or beneath production buildings that are not accessible from outside the building, as this would disrupt building operations Tank investigation activities are summarized in Table 7.4

Stage 1 tank investigation activities will be conducted in accordance with all applicable EMD OPs. Activities will be governed by the OPs as follows

- Tank residue sampling will be performed according to the OP revision presented in Section 11 0

- Prework radiation survey of boring locations will conducted according to OP FO.16, Field Radiological Measurements

- Prior to drilling, boring locations will be cleared according to OP GT 10, Borehole Clearing

- Surface soil samples will be collected using the grab method per OP GT.8, Surface Soil Sampling

- Borings will be drilled and sampled by continuous core auger methods according to OP GT 2, Drilling and Sampling Using Hollow-Stem Auger Techniques

- Boring locations will be surveyed to achieve final location and elevation accuracies of ±0 1 feet per OP GT 17, Land Surveying

Tank Inspections

OPWL tanks will be inspected to visually assess tank integrity Both the interior and exterior of above-grade and on-grade tanks will be inspected Detailed tank inspection work instructions and a form to document the inspection will be developed by the contractor that implements the OU9 Phase I RFI/RI Observations of poor tank integrity (e g , excessive corrosion, holes, cracks, and visual indication of contamination) will be documented and used to focus subsequent soil sampling efforts Where possible, tank inspection will be conducted remotely to mitigate the need for entry into confined spaces Access permits will be required to inspect some tank locations (see OPWL tank field inspection records in Appendix E)

As discussed in Section 2.2 3, many OPWL tanks are located in small structures ("process waste pits") that serve as secondary containment for the tanks Inspection of such tanks will include a visual assessment of the integrity of these structures Again, observations of poor integrity will be used to focus soil sampling locations around the structures OPWL pipeline valve vaults (Section 7 3 1 1) will also be visually inspected to assess their integrity

Residue Sampling

One residue sample will be collected from each tank which has not been cleaned since removal from process waste service to help characterize OPWL wastes In instances where no residue is present, one wipe sample will be taken on the interior surfaces of the tank (preferably at the base of the tank or near pipeline connections) Wipe samples will be collected and tested according to OP FO.16, Field Radiological Measurements This will provide a qualitative measure of radionuclide contamination Where possible, residue or wipe samples will be collected remotely, to mitigate the need for entry into confined spaces In addition, inside surface radiological dose rate measurements will be obtained by inserting a low energy gamma probe radiation detector into the tank These measurements will be useful in verifying tank historical data and allow for future disposal criteria.

Boring Locations

Borings will be drilled and sampled during the Stage 1 tank investigation to identify areas of contamination immediately adjacent to the tank location As discussed in the tank release conceptual model (Section 2 5 2 2), contamination will most likely to exist at the following locations around OPWL tanks

- Beneath or near external connections and openings
- Near joints or corners around underground tanks
- Beneath the base of the tank

Areas beneath or near external connections and openings, and near joints or corners around underground tanks, will be targeted as primary boring locations Known or suspected release locations identified during the additional data compilation activities (Section 7 2 4) will also be targeted as primary boring locations, as will any "hot spots" identified through the surface radiation surveys.

Because OPWL tank locations vary widely in size and configuration, a nominal pattern for borings is not appropriate As a general rule, it is proposed that one boring be drilled on each accessible side of the tank location If field observations suggest that more or less borings are needed to adequately characterize the soils immediately surrounding a tank location (i.e., for very large or very small tank locations), proposed boring locations for the particular site will be documented in technical memorandum TM1 and approved prior to implementation In all cases, borings will be drilled as close as possible to the tank structure

Sampling of Borings

Nominal boring sampling locations for the Stage 1 tank investigation are illustrated in Figure 7-6 One discrete soil sample will be collected at each of the following locations

- Ground surface (prior to drilling)
- One to three feet below the base of below-grade tanks unless base of tank is in bedrock, for above-grade or on-grade tanks, mid-depth between the ground surface and the water table or alluvium/bedrock interface, whichever is encountered first
- Directly above the water table or bedrock/alluvium contact, whichever is encountered first
- In bedrock at the bedrock/alluvium contact if groundwater is not encountered above the contact (i e , where the vadose zone extends to the bedrock/alluvium contact)

Regardless of whether the water table is encountered during drilling, a soil sample will be collected if possible from the interval one to three feet below the base of underground tanks. If the base of the tank extends into bedrock, however, samples will be collected from the alluvium/bedrock interface and drilling will discontinue Examples of these various sampling scenarios are provided in Figure 7-6

Surface soil samples will be collected using the grab method described in OP GT.8, Surface Soil Sampling Each surface soil sample will consist of a 6-inch square area sampled to a depth of 6 inches Borings will be drilled and sampled in accordance with OP GT 2, Drilling and Sampling Using Hollow-Stem Auger Techniques, using the continuous core auger method. A three-inch inside diameter sample barrel will be used to collect 2-foot long samples from the borings. A sample volume of 2,250 cubic centimeters (approximately 140 cubic inches) will be required to perform the analyses specified in Section 7 4

Recent water level monitoring data, combined with information from alluvial isopach maps, will be used to predict depths to the water table and to bedrock at the various tank locations. If the depth between the ground surface and the water table or bedrock is less than 5 feet at above-grade or on-grade tank locations, the mid-depth soil sample will be omitted

Removed Tanks

Some OPWL tanks are known to have been physically removed after being taken out of service Tanks known to have been removed are identified in the OPWL Data Summary Sheets (Appendix B) and are highlighted on the OPWL Location Map (Figure 2-2) Additional data compilation activities may identify other removed tanks

The locations of all removed tanks will be identified to the extent possible using historical information, which may include engineering drawings, aerial photographs, and construction records documenting the removal of the tank As shown in Figures 7-5 and 7-6, Stage 1 investigation of removed tanks will consist of a single boring drilled as closely as possible to the center of the original tank location Where multiple tanks existed at a single location, borings will be drilled at the original center of each individual tank location Discrete soil samples will be collected from the borings in the same manner and at the same depth intervals described above for the original tank type (i e , below-grade, above-grade, and on-grade tanks). Samples will be collected at the ground surface, one to three feet below the base of below-grade tanks unless base of tank is in bedrock, for above-grade or on-grade tanks, mid-depth between the ground surface and the water table or the alluvium/bedrock interface (whichever is encountered first), and directly above the water table or the alluvium/bedrock interface

7 3 2 2 Stage 2 Investigation

As discussed in Section 7.2 1, the Stage 2 tank investigation is designed to determine the horizontal and vertical extent of contamination in vadose zone soils surrounding OPWL tank locations identified as contaminated during the Stage 1 tank investigation These tank locations will be identified in technical memorandum TM2 (Table 7 1) and further investigated by drilling and sampling additional borings

As with Stage 1 boring locations, the unique configuration of each OPWL tank location makes it impractical to establish a nominal sampling pattern for Stage 2 activities. As such, Stage 2 boring locations and subsurface sampling frequency will be developed on a case-by-case basis The proposed Stage 2 investigation for each tank location will be documented in technical memorandum TM2 and approved prior to implementation

The procedures described in Section 7 3 1 2 for drilling and sampling Stage 1 borings will also apply to Stage 2 borings

The Stage 2 tank investigation is designed to fully assess the lateral and vertical extent of contamination in vadose zone soils affected by tank releases It is reasonable to expect that Stage 2 will be implemented in stages in order to meet this objective, with borings located increasingly distant from the contaminant source until the lateral extent of vadose zone soils contamination is delineated Additional intermediate stages in the Stage 2 tank investigation will be addressed in technical memorandum TM3 (Table 7 1) and/or subsequent technical memoranda As discussed in Section 7 2 2, the extent of contamination will be determined through comparison of analytical results to values provided for Rocky Flats Alluvium and bedrock in the Final Background Geochemical Characterization Report (EG&G, 1991d), or to the most current background data available at the time the FSP is implemented, and to values specified in potential ARARs

7 4 SAMPLE ANALYSIS

This section describes the sample handling procedures and analytical program for samples collected during the OU9 Phase I RFI/RI, including sample designations, analytical requirements, sample containers and preservation, and sample handling and documentation

7 4 1 Sample Designation

All sample designations generated for the OU9 Phase I RFI/RI will conform to the input requirements of RFEDS Each sample designation will contain a nine-character sample number consisting of a two-letter prefix identifying the media samples (e g , "SB" for soil borings, "SS" for surface soils), a unique five-digit number, and a two-letter suffix identifying the contractor. One sample number will be required for each sample generated, including QC samples In this manner, 99,999 unique sample numbers are available for each sample media for each contractor that contributes sample data to the database Boring numbers will be developed independently of the sample number for a given boring These sample numbering procedures are consistent with the RFP sitewide QAPjP

7 4 2 Analytical Requirements

As discussed in Section 7 2 2, analytical parameters for Stage 1 samples (Table 7 2) are based on Phase I RFI/RI analyte lists developed for other RFP OUs for which operational history or release history is not clearly defined In general, Stage 1 residue, soil, bedrock, and groundwater samples will be analyzed for each of the following chemical and radionuclide parameters:

- Target Analyte List (TAL) Metals
- Total Organic Carbon (TOC)
- Target Compound List (TCL) Volatiles
- TCL Semivolatiles
- Radionuclides (gross alpha, gross beta, uranium 233+234, 235, and 238, americium 241, plutonium 239+240, tritium, cesium 137, and strontium 89+90)
- Anions (nitrate, sulfate, chloride, and fluoride)

- pH
- Specific conductance

Field measurements of temperature, pH, and specific conductance will be taken on groundwater samples collected from test pits during the Stage 1 pipeline investigation, in accordance with OP SW 2, Field Measurements of Surface Water Field Parameters. Because these samples are not subject to the same conditions as surface water, the total residual chlorine measurement stipulated in OP SW 2 will not be required

Wipe samples will be analyzed according to OP FO 16, Field Radiological Measurements This will provide a qualitative measure of radionuclide contamination

The OU9 Stage 1 analytical parameter list may be modified for some areas of the OPWL based on the results of additional data compilation activities (Section 7 2 4), as discussed in Section 7 2.2

Stage 2 analytical parameters will focus on only those contaminants identified by Stage 1 analytical results, as discussed in Section 7 2 2 Decisions regarding Stage 2 analytical parameter selection will be documented in technical memorandum TM2 (Table 7.1)

7 4 3 Sample Containers and Preservation

Sample volume requirements, preservation techniques, holding times, and container material requirements are dictated by the media being sampled and by the analyses to be performed Analytical parameters of interest in OU9 for residue, soil, and groundwater matrices, along with the associated container size, preservatives (chemical and/or temperature), and holding times are listed in Table 7 5 Additional specific guidance on the appropriate use of containers and preservatives is provided in OP FO 13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples

7 4 4 Sample Handling and Documentation

Sample control and documentation is necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field Accountable documents include logbooks, data collection forms, sample labels or tags, chain-of-custody forms, photographs, and analytical records and reports Specific guidance defining the necessary sample control, identification, and chain-of-custody documentation is discussed in OP FO 13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples

7 5 DATA MANAGEMENT AND REPORTING

Field data will be input to the RFEDS using a remote data entry module supplied by EG&G Data will be entered on a timely basis, and a 3 5-inch computer diskette will be delivered to EG&G A hard copy report will be generated from the module for contractor use The data will undergo a prescribed QC process based on OP FO 14, Field Data Management

A sample tracking spreadsheet will be maintained by the contractor for use in tracking sample collection and shipment EG&G will supply the spreadsheet format and will stipulate timely reporting of information These data will also be delivered to EG&G on 3 5-inch computer diskettes Computer hardware and software requirements for contractors using government-supplied equipment will be supplied by EG&G. Computer and data security measures will also follow acceptable procedures outlined by EG&G

As mentioned previously, forms will be developed to document the results of tank investigations and test pit excavation Forms provided in the various OPs referenced in Sections 7 2, 7 3, and 7 4 will also be utilized as appropriate to document and manage the data obtained during the OU9 Phase I RFI/RI

7 6 FIELD QC PROCEDURES

Sample duplicates, field preservation blanks, and equipment rinsate blanks will be prepared Trip blanks will be obtained from the laboratory The analytical results obtained for these samples will be used by the EMD project manager to assess the quality of the field sampling effort The types of field QC samples to be collected and their application are discussed below The frequency with which QC samples will be collected and analyzed is provided in Table 7 6

Duplicate samples will be collected by the sampling team for use as a relative measure of the precision of the sample collection process These samples will be collected at the same time, using the same procedures and equipment, and in the same types of containers as required for the samples They will also be preserved in the same manner and submitted for the same analyses as required for the samples

Field blanks of distilled water will be prepared by the sampling team and will be used to provide an indication of any contamination introduced during field sample preparation

Equipment (rinsate) blanks will be collected from final decontamination rinsate to evaluate the success of the field sampling team's decontamination efforts on non-dedicated sampling equipment Equipment blanks are obtained by rinsing cleaned equipment with distilled water prior to sample collection The rinsate is collected and placed in the appropriate sample containers

Trip blanks consisting of distilled water will be prepared by the laboratory technician and will accompany each shipment of samples for volatile organic analysis Trip blanks will be stored with the group of samples with which they are associated Analysis of the trip blank will indicate migration of volatile organics or any problems associated with sample shipment, handling, or storage Information from the trip blanks will be used in conjunction with air monitoring data and other information to assess the influence of ongoing waste operations on the quality of data collected

Procedures for monitoring field QC are provided in the sitewide QAPjP

7.7 AIR MONITORING AND SAMPLING PROCEDURES

Air monitoring will be performed during field activities to ensure that quality data are obtained during sampling and that all sampling activities comply with the Interim Plan for Prevention of Contaminant Dispersion (IPPCD) (EG&G, 1991g) and in accordance with OP FO.1, Air Monitoring and Dust Control. It is expected that the Final PPCD will be completed by the time the OU9 RFI/RI is implemented.

Air quality monitoring requirements for activities such as borehole drilling where there is a significant potential for producing appreciable quantities of suspended particulates include the following:

- Site perimeter and community Radiological Ambient Air Monitoring Program (RAAMP) monitoring

- Local monitoring of Respirable Suspended Particulates (RSP) at individual activity work sites shall be conducted using a TSI "Piezobalance" Model 3500 Respirable Aerosol Mass Monitor, a real-time instrument Local RSP measurements will be used to guide the project manager's evaluation of the potential hazards associated with activity-related emissions The threshold RSP concentration for curtailing intrusive activities will be 6 0 milligrams/cubic meter (mg/m^3)

- Additional worker health and safety monitoring as required by the Site-Specific Health and Safety Plan (SSH&SP)

As mentioned in Sections 2 5 4 and 5 6, a primary goal of the Phase I RFI/RI is to support quantitative evaluation of human health risk due to inhalation of contaminants derived from OU9 surface soils Inhalation exposure often is evaluated by assuming a conservative suspended particulate concentration in ambient air Direct measurement of suspended particulate concentration can eliminate much of the uncertainty in this assumption However, any surface soil contamination as a result of OPWL releases is expected to occur as individual sites of limited area scattered throughout the RFP main production facility As a result, suspended particulate data from air samples collected in the vicinity of these sites probably would be representative of the main production facility as a whole

Total suspended particulate and respirable particulate data are collected at a monitoring station located near the RFP east gate, downwind of the main production facility Suspended particulate data also have been collected in the vicinity of the 903 Pad immediately southeast of the main production facility, and may be collected for other RFP OUs prior to or during the OU9 Phase I RFI/RI. If areas of surface soil contamination are identified at OU9 during Phase I field activities, suspended particulate data from these sources will be evaluated for applicability to OU9 inhalation exposure evaluation If appropriate, these data will be used to provide a conservative estimate of total suspended particulates and respirable particulates in the vicinity of OU9 However, if it is determined that these data may not be representative of OU9 conditions, an OU9-specific air sampling program will be designed to provide the necessary data This air sampling program will be addressed as necessary in technical memorandum TM3 (Table 7 1)

TABLE 7.1

OU9 PHASE I RFI/RI TECHNICAL MEMORANDA

Tech Memo Number	Due Date	Topics Addressed
TM1	Following completion of additional data compilation activities	• Results of additional data compilation activities • Detailed plan for surface radiation survey [a] • Stage 1 pipeline investigation FSP [b] • Stage 1 tank investigation FSP [b]
TM2	Following completion of Stage 1 pipeline and tank investigations	• Results of Stage 1 pipeline and tank investigations • Stage 2 pipeline investigation FSP [b] • Stage 2 tank investigation FSP [b]
TM3	Following completion of Stage 2 pipeline investigation and first round of Stage 2 tank investigation	• Results of Stage 2 pipeline investigation • Results of first round of Stage 2 tank investigation • Stage 3 pipeline investigation FSP [b] • FSP for additional Stage 2 tank investigation [b] • Need for tensiometer nests at specific release locations • Need for site-specific air monitoring

a If any modifications to the Stage 1 FSPs are necessary based on the results of surface radiation surveys, then the survey results and the necessary FSP modification(s) will be addressed in a separate technical memorandum If no FSP modifications are necessary, the surface radiation survey results will be addressed in the Phase I RFI/RI Report

b Surface soil samples will be collected at each test pit and borehole location during the Stage 1, Stage 2, and Stage 3 pipeline and tank investigations

TABLE 7.2

ANALYTICAL PARAMETERS AND DETECTION/QUANTITATION LIMITS FOR STAGE 1 SAMPLING ACTIVITIES AT OU 9

Analytical Parameter	Water Limits	Soil Limits
Target Analyte List Metals[†]	(µg/l)	(mg/kg)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1 0
Cadmium	5	1 0
Calcium	5000	2000
Cesium*	1000	200
Chromium	10	2 0
Cobalt	50	10
Copper	25	5 0
Cyanide	10	10
Iron, Total	100	20
Lead	5	1.0
Lithium*	100	20
Magnesium	5000	2000
Manganese, Total	15	3 0
Mercury	0 2	0 2
Molybdenum*	200	40
Nickel	40	8 0
Potassium	5000	2000
Selenium	5	1 0
Silver	10	2 0
Sodium	5000	2000
Strontium*	200	40
Thallium	10	2 0
Tin*	200	40
Vanadium	50	10 0
Zinc	20	4 0
Total Organic Carbon[†]	1 µg/l	1 mg/kg

TABLE 7.2

ANALYTICAL PARAMETERS AND DETECTION/QUANTITATION LIMITS FOR STAGE 1 SAMPLING ACTIVITIES AT OU 9
(Continued)

Analytical Parameter	Water Limits	Soil Limits
Target Compound List Volatiles[‡]	(µg/l)	(µg/kg)
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethene (Total)	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichloromethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
Trans-1,3-Dichloropropene	5	5
Bromoform	5	5
4-Methyl-2-pentanone	5	10
2-Hexanone	10	10
Tetrachloroethene	10	5
Toluene	5	5
1,1,2,2,-Tetrachloroethane	5	5
Chlorobenzene	5	5
Ethyl Benzene	5	5
Styrene	5	5
Total Xylenes		5

TABLE 7.2

ANALYTICAL PARAMETERS AND DETECTION/QUANTITATION LIMITS FOR STAGE 1 SAMPLING ACTIVITIES AT OU 9
(Continued)

Analytical Parameter	Water Limits	Soil Limits
Target Compound List Semivolatiles[‡]	(ug/l)	(ug/kg)
Phenol	10	330
bis(2-Chloroethyl)ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
Benzyl alcohol	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-propylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic acid	50	1600
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1600
2-Chloronapthalene	10	330
2-Nitroaniline	50	1600
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	50	1600

TABLE 7.2

ANALYTICAL PARAMETERS AND DETECTION/QUANTITATION LIMITS FOR STAGE 1 SAMPLING ACTIVITIES AT OU 9
(Continued)

Analytical Parameter	Water Limits	Soil Limits
Acenaphthene	10	330
2,4-Dinitrophenol	50	1600
4-Nitrophenol	50	1600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
4-Chlorophenyl-phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1600
4,6-Dinitro-2-methylphenol	50	1600
N-nitrosodiphenylamine	10	330
4,-Bromophenyl-phenylether	10	330
Hexachlorobenzene	10	330
Pentachlorophenol	50	1600
Phenanthrene	10	330
Anthracene	10	330
Di-n-butylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzylphthalate	10	330
3,3'-Dichlorobenzidine	20	660
Benzo(a)anthacene	10	330
Chrysene	10	330
bis(2-Ethylhexyl)phthalate	10	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330

TABLE 7.2

ANALYTICAL PARAMETERS AND DETECTION/QUANTITATION LIMITS FOR STAGE 1 SAMPLING ACTIVITIES AT OU 9

(Continued)

Analytical Parameter	Water Limits	Soil Limits
Radionuclides[†]	(pCi/l)	(dry)(pCi/g)
Gross Alpha	2	4
Gross Beta	4	10
Uranium 233+234, 235, and 238 (each species)	0 6	0 3
Americium 241	0 01	0.02
Plutonium 239+240	0 01	0.03
Tritium	400	400 (pCi/ml)
Cesium 137	1	0 5
Strontium 89+90	1	1
Anions[†]	(mg/l)	
Nitrate/Nitrite	5	TBD
Sulfate	5	TBD
Chloride	5	TBD
Fluoride	0 1	TBD
pH	0 1 pH unit	TBD
Specific Conductance	TBD	TBD

[†]Limits refer to detection limits
[‡]Limits refer to quantitation limits
*Non-CLP TAL Metals detection limit
TBD - To be determined

Note Detection and quantitation limits are highly matrix dependent. The limits listed here are the minimum achievable under ideal conditions Actual limits may be higher

Detection/quantitation limits for residue samples are not specified by the GRRASP. The unknown nature of this matrix prevents establishment of specific limits Detection/quantitation limits will be the minimum obtainable for a given matrix

TABLE 7.3

SUMMARY OF PHASE I RFI/RI INVESTIGATION ACTIVITIES AT OU9

ACTIVITY	PURPOSE	METHOD	SAMPLE ANALYTES	SAMPLING FREQUENCY
Additional Data Compilation Activities	**Assemble and review all available information on OPWL to direct field sampling activities**			
• Site Walk • Interviews • Records Review	Provide information to direct field sampling activities	N/A	N/A	N/A
Surface Radiation Survey	**Characterize surface soil contamination at selected OPWL release sites**			
Surface radiation surveys using instrumentation and methodology per EMD OPs	Provide information to focus Stage 1 sampling locations	Conduct surface radiation surveys	Qualitative radionuclide	All sites of known or suspected surface impacts due to OPWL releases, survey pattern to be determined on case-by-case basis

TABLE 7.3

SUMMARY OF PHASE I RFI/RI INVESTIGATION ACTIVITIES AT OU9
(Continued)

ACTIVITY	PURPOSE	METHOD	SAMPLE ANALYTES	SAMPLING FREQUENCY
Pipeline Investigation	**Characterize contaminant sources and vadose zone soils around OPWL pipeline releases**			
Stage 1 Investigation	• Assess nature of contamination at pipeline release locations • Locate areas of contamination in vadose zone soils at pipeline release locations	• Sample surface soil at each test pit location • Sample trench backfill and native soil underlying trench in test pits • Collect residue or wipe sample from inside pipeline in test pits • Pressure test and/or video inspect pipeline	TAL metals TOC TCL volatiles TCL semivolatiles Selected radionuclides Selected anions pH Specific conductance (Wipe samples--qualitative radionuclide only)	Pipeline structural features, known or suspected pipeline release locations, surface radiation survey hot spots, or maximum 200 ft intervals along all accessible pipelines
Stage 2 Investigation	Provide preliminary assessment of extent of vadose zone soil contamination along pipeline alignments and of contaminant infiltration into bedrock	• Sample surface soil at each boring location • Sample trench backfill, native soil, and vadose zone bedrock in borings	Analytes of concern identified in Stage 1 investigation	Soil borings at 5 and 20 foot intervals along pipeline alignments adjacent to contaminated Stage 1 test pits
Stage 3 Investigation	Assess horizontal and vertical extent of contamination in vadose zone soils around pipeline release locations and provide partial assessment of contaminant infiltration into vadose zone bedrock	• Evaluate need for Stage 3 on site-by-site basis • Sample surface soil at each boring location • Sample trench backfill, native soil, and vadose zone bedrock in borings	Analytes of concern identified in Stage 1 and 2 investigations	All pipeline release locations determined to require further investigation based on Stage 1 and 2 results, boring locations to be determined on case-by-case basis for each location

TABLE 7.3

SUMMARY OF PHASE I RFI/RI INVESTIGATION ACTIVITIES AT OU9
(Continued)

ACTIVITY	PURPOSE	METHOD	SAMPLE ANALYTES	SAMPLING FREQUENCY
Tank Investigation	**Characterize contaminant sources and vadose zone soils around OPWL tank locations**			
Stage 1 Investigation	• Assess nature of contamination at tank locations • Locate areas of contamination in vadose zone soils at tank release locations and provide partial assessment of contaminant infiltration into vadose zone bedrock	• Visually inspect tank • Collect residue or wipe sample from inside tank • Sample surface soil at each boring location • Sample backfill, native soil, and vadose zone bedrock surrounding tank locations in borings	TAL metals TOC TCL volatiles TCL semivolatiles Selected radionuclides Selected anions pH Specific conductance (Wipe samples--qualitative radionuclide only)	All tanks that are not part of active waste management units, specific boring locations around each tank location to be determined on case-by-case basis
Stage 2 Investigation	Assess horizontal and vertical extent of contamination in vadose zone soils around tank locations and provide partial assessment of contaminant infiltration into vadose zone bedrock	• Evaluate need for Stage 2 investigation on site-by-site basis • Sample surface soil at each boring location • Sample backfill, native soil, and vadose zone bedrock in borings	Analytes of concern identified in Stage 1 investigation	All tanks determined to require further investigation based on Stage 1 results; specific boring locations to be determined on case-by-case basis

TABLE 7.4

FIELD INVESTIGATION PLAN SUMMARY FOR OPWL TANKS

Tank Location	Field Investigation Summary			Explanation[1]
	Inspection	Waste Samples	Soil Samples	
T-1			X	One underground tank, removed, outside Building 122
T-2				One underground tank, abandoned, beneath south wing of Building 441
T-3	X	X	X	One aboveground tank, abandoned, outside Building 441 One underground tank, abandoned, inside Building 441 process waste pit (Building 429)
T-4	X	X		Three floor sumps, active (incidental spill control), inside Building 447 basement
T-5				Two abovegrade tanks, active (Part B Hazardous & Low-Level Permit Application Unit Nos. 40.04 and 40 05), inside Building 444 basement
T-6	X	X		Two floor sumps, active (foundation drainage), inside Building 444 basement
T-7				Two abovegrade tanks, active (90-day transuranic waste accumulation tanks, Unit Nos. 522 and 523), inside Building 559 process waste pit (Building 528)
T-8	X	X	X	Two underground tanks, converted to plenum deluge system, inside Building 771 process waste pit (Building 728)
T-9, T-10	X	X	X	Four underground tanks, two converted to plenum deluge system, two abandoned, inside Building 776 process waste pit (Building 730)
T-11, T-30				T-11 Two underground sumps, active (Part B Secondary Containment Reference No 2011), inside Building 707 process waste pit (Building 731) T-30 One underground sump, active (Part B Secondary Containment Reference No. 2011), Building 707 process waste pit (Building 731, T-30 is the Building 731 structure itself)
T-12				Not a valid OPWL tank location

TABLE 7.4

FIELD INVESTIGATION PLAN SUMMARY FOR OPWL TANKS
(Continued)

Tank Location	Field Investigation Summary			Explanation[1]
	Inspection	Waste Samples	Soil Samples	
T-13	X	X		One underground sump, abandoned, inside Building 774 basement
T-14, T-16	X	X	X	Three underground tanks, abandoned, outside Building 774
T-15, T-17				Six underground tanks, removed, beneath south wing of Building 774
T-18	X	X		One underground sump, abandoned, inside Building 778
T-19, T-20	X			Four underground sumps, two converted to plenum deluge system, two abandoned, all cleaned and painted after removal from process waste system, in Building 779 basement
T-21, T-22	X	X	X	T-21 One floor sump, abandoned, inside Building 886 process waste pit (Building 828) T-22 Two abovegrade tanks, abandoned, inside Building 886 process waste pit (Building 828)
T-23	X			One underground sump, abandoned (but presently contains the base of the Building 865 electron beam furnace), cleaned and painted, inside Building 865
T-24, T-32				T-24 Seven abovegrade tanks, active (Part B Hazardous and Low-Level Mixed Permit Application Unit Nos 40 20 - 40 26), inside Building 881 process waste pit (Building 887) T-32 One underground sump, active (Part B Secondary Containment Reference No 2014), Building 881 process waste pit (Building 887, T-32 is the Building 887 structure itself)

TABLE 7.4

FIELD INVESTIGATION PLAN SUMMARY FOR OPWL TANKS
(Continued)

Tank Location	Field Investigation Summary			Explanation[1]
	Inspection	Waste Samples	Soil Samples	
T-25, T-26				T-25 Two abovegrade tanks, active (Part B Hazardous and Low-Level Mixed Permit Application Unit Nos 40 30 and 40 31), inside Building 883 T-26: Three abovegrade tanks, active (Part B Hazardous and Low-Level Mixed Permit Application Unit Nos. 40.39 - 40 41), inside Building 883
T-27			X	One abovegrade tank, removed, outside Building 886
T-28	X	X		Two floor sumps, active (incidental spill control), inside Building 889
T-29	X	X	X	One on-grade tank, abandoned, outside Building 774
T-31				Not a valid OPWL tank location
T-33, T-34, T-35				Not valid OPWL tank locations
T-36, T-37	X	X		Two underground sumps, abandoned, inside Building 771C
T-39				Four abovegrade tanks, removed, former tank location has been thoroughly cleaned and decontaminated, inside Building 881

1 See Section 7 3 2 and Figure 7-5 for tank investigation decision rationale

TABLE 7.5

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR RESIDUE, SOIL, AND WATER SAMPLES

RESIDUE AND SOIL SAMPLES

Parameter	Container	Preservative	Holding Time
TAL Metals	1 x 250 mℓ wide-mouth glass jar	Cool, 4°C	180 days[1]
Cyanide	1 x 250 mℓ wide-mouth glass jar	Cool, 4°C	14 days
TCL Volatiles	2 x 125 mℓ wide-mouth Teflon-lined jar	Cool, 4°C	7 days
TCL Semivolatiles	1 x 250 mℓ wide-mouth Teflon-lined jar	Cool, 4°C	7 days until extraction, 40 days after extraction
Radionuclides	1 x 1 ℓ wide-mouth glass jar	None	180 days
TOC, Anions, pH, and specific conductance	1 x 250 mℓ wide-mouth glass jar	Cool, 4°C	28 days

[1]Holding time for mercury is 28 days

WATER SAMPLES

Parameter	Container	Preservative	Holding Time
TAL Metals	1 x 1 ℓ polyethylene bottle	Nitric acid pH <2, Cool, 4°C	180 days[1]
Cyanide	1 x 1 ℓ polyethylene bottle	Sodium hydroxide pH >12, Cool, 4°C	14 days
TCL Volatiles	2 x 40 mℓ VOA vials with teflon-lined septum lids	Cool, 4°C	7 days
TCL Semivolatiles	1 x 4 ℓ amber glass bottle	Cool, 4°C	7 days until extraction, 40 days after extraction
Radionuclides	12 ℓ polyethylene bottle(s)	Nitric acid pH <2, Cool, 4°C	180 days
TOC	1 x 250 mℓ polytehylene bottle	Sulfuric acid pH <2, Cool, 4°C	28 days
Anions	1 x 1 ℓ polyethylene bottle	Cool, 4°C	28 days
Nitrate/Nitrite	1 x 250 mℓ polyethylene bottle	Sulfuric acid pH <2; Cool, 4°C	28 days
pH, temperature, and specific conductance	In-situ, beaker or bucket	None	Analyze immediately

[1]Holding time for mercury is 28 days

TABLE 7.6

FIELD QC SAMPLE FREQUENCY

Sample Type	Type of Analysis	Sample Frequency	
		Solids	Liquids
Duplicates	Organics	1/10	1/10
	Inorganics	1/10	1/10
	Radionuclides	1/10	1/10
Field Blanks	Organics	N/R	N/R
	Inorganics	1/20	1/20
	Radionuclides	1/20	1/20
Equipment Blanks	Organics	1/20	1/20
	Inorganics	1/20	1/20
	Radionuclides	1/20	1/20
Trip Blanks	Organics	1/20	1/20
	Inorganics	N/A	N/A
	Radionuclides	N/A	N/A

N/A = Not Applicable
N/R = Not Required
1/10 = one QC sample per ten samples collected

Approved By

_____________________ __/__/__
Work Plan Manager (Date)

_____________________ __/__/__
Division Manager (Date)

Effective Date. ____________________

8.0 HUMAN HEALTH RISK ASSESSMENT PLAN

8 1 OVERVIEW

Section 300 430(d) of the National Contingency Plan states that as part of the remedial investigation, a Baseline Risk Assessment is to be conducted to determine whether contaminants of concern identified at the site pose a current or potential future risk to human health (Human Health Risk Assessment) and the environment (Environmental Evaluation) in the absence of remedial action. This section describes the Human Health Risk Assessment components which include:

- Data Collection/Evaluation
- Exposure assessment
- Toxicity assessment
- Risk characterization

The Environmental Evaluation is described in Section 9 0 of this Work Plan

Figure 8-1 illustrates the basic Human Health Risk Assessment process and components The Human Health Risk Assessment objective is to identify and assess potential human health risks resulting from exposure to site contaminants present in various environmental media Several objectives will be accomplished under the Human Health Risk Assessment task, including identification and characterization of the following

- Toxicity and levels of hazardous substances present in relevant media (e.g , air, ground-water, soil, surface water, sediment, and biota)

- Environmental fate and transport mechanisms within specific environmental media, and inter-media fate and transport where appropriate

- Potential human and environmental receptors

- Potential exposure routes and extent of actual or expected exposure

- Extent of expected impact or threat, and the likelihood of such impact or threat occurring (e g , risk characterization)

- Level(s) of uncertainty associated with the above

Human Health Risk Assessment results will be used to determine if remedial actions are warranted at OU9 and, if so, the associated cleanup levels necessary to protect human health.

A number of EPA guidance documents will be used to provide direction for developing the Human Health Risk Assessment The documents listed in Table 8 1 constitute the most recent EPA guidance in public health risk assessment It must be emphasized that EPA manuals are guidelines only, and that EPA states that considerable professional judgement must be used in their application The focus of the risk assessment for OU9 will be to produce a realistic analysis of exposure and health risk.

To accomplish the characterization of the magnitude of the exposure/dose assessment for radionuclides, a number of documents will be referenced, including but not limited to DOE Order 5400 5, Federal Guidance Report No 10 (EPA, 1984), and Federal Guidance Report No 11 (EPA, 1988d). The dose calculations shall provide an estimate of the committed effective dose equivalent to an individual in the population which can then be compared to lifetime risk from radiation exposure. Estimates of lifetime risk of cancer to exposed individuals resulting from radiological and chemical risk assessments will be tabulated separately in the final human health risk assessment In addition to available national EPA guidance, supplemental Region VIII risk assessment guidance will be used if applicable

The following Human Health Risk Assessment Plan will be applicable to both Phase I and Phase II RFI/RI tasks undertaken at OU9 Phase I RFI/RI objectives are limited to characterization of the source term and soil contamination As described in Section 2 5 4, the limited scope of Phase I data collection will support quantitative evaluation of soil ingestion, inhalation, and dermal contact exposure pathways These pathways will be evaluated at locations where surficial soil contamination is determined to exist due to OPWL releases Phase I will also allow identification of potential exposure pathways involving surface water, groundwater, and biota as transport media. These pathways will be quantitatively evaluated, if necessary, during Phase II

Although limited in scope, the Phase I characterization must meet the applicable data needs and data usability described in this section Existing available information on ground water, surface water, and air quality will be incorporated to the extent practicable This information can then be applied to each component of the risk assessment process, and a partial Human Health Risk Assessment will be developed

8 2 DATA COLLECTION/EVALUATION

This section outlines the process that will be used to identify source-related contaminants present at OU9 at concentrations that could be of concern to human health This process includes a summary of historical and RFI/RI related data collected at OU9, an evaluation of historical and RFI/RI data relevant to performing the Human Health Risk Assessment, and use of this information to identify contaminants of concern (COCs) COCs include chemicals and other constituents, such as metals or radionuclides, that are identified at the unit and evaluated in the Human Health Risk Assessment

8 2 1 Data Collection

The first step in the process is a summary of all data available for use in the Human Health Risk Assessment This step identifies the historical data relevant to performing the Human Health Risk Assessment, assembles Phase I RFI/RI data as they become available, and establishes data formats to facilitate data evaluation Data attributes important to this step include the following information.

- Site description

- Sample design with sampling locations
- Analytical method and detection limit
- Results for each sample, including qualifiers
- Sample quantitative limits and/or detection limits for non-detects
- Field conditions

8 2 2 Data Evaluation

Historical and Phase I RFI/RI data will be further evaluated in part by EPA's guidelines issued in Guidance for Data Useability in Risk Assessment (EPA, 1990a). Internal EG&G QA/QC guidelines will also be used to evaluate the usability of historical data available EPA has identified the following data useability criteria

- Assess data documentation for completeness
- Assess data sources for appropriateness and completeness
- Assess analytical methods and detection limits for appropriateness
- Assess data validation review
- Assess sampling data quality indicators (completeness, comparability, representativeness, precision, and accuracy)
- Assess analytical data quality indicators (such as spike recoveries, duplicates, and blanks) for completeness, comparability, representativeness, precision, and accuracy

Following completion of the Phase I RFI/RI data collection, analysis, and validation, new data will be evaluated to determine if they support historical trends Where new data and historical data appear compatible, the historical data will undergo re-evaluation to identify those that could be used quantitatively in conjunction with new data

Based on the outcome of this evaluation, the data set containing historic :l and Phase I RFI/RI data that can be used to support a quantitative Human Health Risk Assessment will be identified Part of this evaluation will include the most appropriate summary process and format This will involve identifying statistical summary techniques that consider spatial and temporal data distributions, determining if arithmetic or geometric means are appropriate, and determining the appropriate method for dealing with non-detected values and qualified data The data summary will include

- The frequency of detection (number of positive detects/number of analyses) for each compound and sample location
- The minimum- and maximum-reported concentrations for each compound at each sample location

Tentatively identified compounds (TICs) reported in the Phase I RFI/RI data will be evaluated relative to their usefulness in the Human Health Risk Assessment If only a few TICs are reported relative to other contaminants, or if they are unrelated to the RFP, they will be excluded from the Human Health Risk Assessment If numerous TICs are reported and they appear related to the RFP, they will be carried through the Human Health Risk Assessment only to the extent that they aid in characterizing human health risk as needed for site decisions It is unlikely that risks resulting from exposure to TICs cannot be characterized at this time because of the absence of specific contaminant identity and available toxicological information

8 2 3 <u>Hazard Identification</u>

The objective of the hazard identification is to identify RFP-related COCs present at OU9 in concentrations high enough that may be of concern relative to human health considerations Criteria for performing the hazard identification include but may not be limited to

- Frequency of detection
- Environmental media concentrations exceed background concentrations
- Toxicity, mobility, and persistence

From the list of valid data suitable for use in the risk assessment, potential site-specific COCs may be identified based on the following considerations

- The chemical is identified as a site-specific, waste activity related compound released from an identified source at the IHSS

- The concentration of the chemical exceeds the chemical-specific ARARs

- The chemical is detected at a frequency greater than 5 percent of the time in an individual media (e.g , surface soil, subsurface soil, alluvial ground water, etc)

- The concentration of the chemical exceeds the 95 percent Upper Tolerance Limit of the background concentration estimate

- The chemical is a potential carcinogenic compound classified as: Group A - sufficient evidence of carcinogenicity in humans, Group B1 - limited evidence of carcinogenicity in humans, and Group B2 - sufficient evidence in animals with inadequate evidence in humans

- The occurrence of a non-carcinogenic compound in media at a concentration 0.1 times the derived media concentration (DMC) (The DMC equals the exposure dose divided by the reference dose)

- The chemical's inter-media transport, persistence, and biometabolic characteristics.

- The chemical's role as a nutrient

Depending on the number of site-related contaminants identified, one of two things will happen under both current and potential future conditions

1 If only a few site-related contaminants are identified, all of them will be carried through the risk assessment The contaminants responsible for dominant risks at the site, as well as those contributing lower risk, will be identified.

2 If a large number of site-related contaminants are identified, contaminants of concern may be selected and carried through the risk assessment to characterize only those expected to contribute the highest risk. Contaminants of concern will then be selected in accordance with the Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual (EPA, 1989b) that requires the following.

    - Evaluating site historical information

    - Evaluating contaminant concentrations and toxicities

    - Examining contaminant mobility, persistence, and bioaccumulation

- Identifying release mechanisms
- Identifying special exposure routes
- Evaluating contaminant treatability (retain those more difficult to treat than others)
- Assessing availability of contaminant ARARs
- Grouping chemicals by class according to structure-activity relationships or other similarities
- Evaluating frequency of detection
- Estimating intake
- Identifying essential nutrients
- Using a concentration-toxicity screen to identify those contaminants that are expected to contribute the most to overall risks

To judge the degree and extent of risk to public health and the environment (including plants, animals, and ecosystems), the projected concentrations of COCs at exposure points will be compared with ARARs, as stated in Section 3.0. Because ARARs do not exist for certain media (such as soils), nor are all ARARs necessarily health based, this comparison is not sufficient in itself to satisfy the requirements of the risk assessment process. Moreover, receptors may be exposed to contaminants in more than one medium so that their total doses might exceed risk reference doses (RfDs) and/or might result in an excess cancer risk greater than an acceptable target risk, as defined by EPA (e.g., 10^{-6} to 10^{-4}). Nevertheless, the comparison with standards and criteria is useful in defining the exceedence of institutional requirements. Aside from the ARARs discussed in Section 3.0, the following criteria will be examined

- Drinking-water health advisories
- Ambient water quality criteria for protection of human health
- Center for Disease Control and Agency for Toxic Substances and Disease Registry soil advisories

- National Ambient Air Quality Standards

Potential COCs will be evaluated in terms of all considerations in an iterative process Thus, a chemical may be eliminated as a COC on the basis of one criterion, but it may subsequently be identified as a COC on the basis of another criterion (and vice-versa) Adequate documentation will be prepared to justify including or excluding specific contaminants.

8 2 4 Uncertainty in Data Collection Evaluation

The assessment of the data collection process listed above involves the evaluation of five indicators: completeness, comparability, representativeness, precision, and accuracy Uncertainty within each of these parameters will influence the selection of COCs, affect the estimates of average and maximum concentration of the chemical, and ultimately influence the risk characterization results. A qualitative identification of the key site variables such as sampling location, sampling frequency, use of historical data, and selection of COCs will be performed for this Data Collection/Evaluation Section

8 3 EXPOSURE ASSESSMENT

The exposure assessment objective is to determine how exposures to site contaminants could occur, and to estimate the extent of exposure if it occurs The exposure assessment includes several tasks.

- Characterize the exposure setting relative to contaminant fate and transport and potentially exposed populations

- Identify exposure pathways based on chemical source and release, exposure point, and exposure route

- Identify uncertainties associated with the exposure assessment that impact the risk characterization

Exposure is defined as the contact of an organism with a contaminant or physical agent The magnitude of exposure is determined by measuring or estimating the amount of a contaminant available at the exchange boundaries (i e , lungs, intestines, and skin) When contaminants migrate from the site to an exposure point (a location where receptors can come into contact with contaminants), or when a receptor directly contacts the contaminated media, exposure can occur The radionuclides present at this OU do produce an external exposure hazard albeit a minor one. Nevertheless, this external exposure route will be assessed and used in the risk characterization

8 3 1 Conceptual Site Model

The site conceptual model for OU9 (Figures 2-8 and 2-9) will be used to evaluate primary and secondary contaminant sources and releases, and potential receptors and associated exposures The model helps to characterize the exposure setting relative to contaminant fate and transport mechanisms through exposed receptors The conceptual site model for OU9 may be revised on RFI/RI data collected for the OU9 to incorporate new information Although not explicitly described by the OU9 conceptual site model, residential and occupational exposure pathways through ingestion, inhalation, or dermal contact with site-related contaminants will be considered for evaluation in the risk characterization if the revised conceptual model suggests they may be complete exposure pathways A completed exposure pathway consists of all five of the elements listed below.

1 Source of contaminant

2 Mechanism of chemical release to the environment

3 Environmental transport medium (e g , air, ground water) for the released constituent

4 Point of potential contact of human or biota with the affected medium (the exposure point)

5 Exposure route (e g , inhalation of contaminated dust) at the exposure point

If any of these five elements is missing from a potential pathway, exposure cannot occur and thus the pathway can be eliminated from the risk assessment process The conceptual model contains all potential exposure pathways, and part of the goal of the RFI/RI Work Plan is to determine if a completed exposure pathway exists

8 3 2 Contaminant Fate and Transport

The conceptual site model helps identify potential contaminant fate and transport mechanisms These could include soil contaminants leaching to ground water, soil entrainment and downwind deposition, or surface runoff that transports surface soil downslope Contaminant-specific characteristics affect fate and transport. Chemical specific factors affecting the probability a contaminant will migrate include, but are not limited to

- Solubility
- Partition coefficient
- Vapor pressure
- Henry's Law constant
- Bioconcentration factor

The evaluation of these chemical specific factors will help determine if contaminants can migrate from their sources to potential receptors, not only those identified under current use scenarios but those identified under potential future exposure scenarios as well

8 3 3 <u>Exposure Pathways</u>

By using the conceptual site model and information on contaminant fate and transport, exposure pathways can be identified The Human Health Risk Assessment will consider only complete exposure pathways (or pathways that could be complete under potential future situations), those for which data support the presence of a source, release mechanism, transport mechanism, exposure route, and affected receptor Complete exposure pathways include the receptors and exposure route (ingestion, inhalation, and dermal)

8 3 4 <u>Potential Receptors</u>

The exposure scenarios that will be developed in the Human Health Risk Assessment may include exposure of on-site workers, exposure of potential future receptors to contaminated media within OU9, and exposure of off-site receptors to potentially contaminated ground water, surface water, and airborne soil particulates The exact exposure scenarios to be considered will be selected according to an assessment of future use (e g , residential, recreational, restricted access) of the site that may be made prior to completion of the Human Health Risk Assessment.

8 3 5 Exposure Point Concentrations

By using the data set identified as part of Section 8 2 2, and the results of contaminant fate and transport modeling, exposure point concentrations of COCs will be estimated on the basis of analytical results of the sampling program described in Section 7 0 and available relevant historical data. Some data will be collected at the point of exposure. Other data collected at the source may be used in conjunction with a transport model to estimate expected concentration at some exposure point Because modeling may add uncertainty, the Work Plan emphasizes collecting data at exposure points where possible (even though these data provide only a snapshot of conditions in time and space).

Release and transport of contaminants in environmental media may be modeled using analytical and/or numerical models recommended and approved by EPA (e g , AIRDOS) or the best model available, as determined by a model performance evaluation The models will be calibrated to improve performance using site-specific parameters The selection of appropriate model(s) will be documented in the BRAP technical memorandum required under VII D 1 b of the IAG Statement of Work (DOE, 1991a)

Model outputs will be characterized by estimating variance through an uncertainty analysis to the extent required by the overall risk uncertainty analysis Reasonable efforts will be made to minimize the variance of model output Other major contributors to the overall risk assessment uncertainty include exposure factors used in the estimation of intake and the toxicity parameters (reference dose and cancer slope factors) used to evaluate the effect of an acquired dose

Exposure point concentrations will be expressed as reasonable maximum exposure (RME) concentrations and average concentrations RME concentrations are represented by the 95th percent confidence limit on the average or the maximum-reported concentration, whichever is lower Depending on the

quantity of data and their appropriateness for grouping, data distribution will be used to determine the appropriateness of using geometric or arithmetic means to estimate the RME concentrations

When feasible, a goodness-of-fit analysis will be conducted to correctly identify the distribution of the data and the most appropriate measure of central tendency The reasonable maximum concentration will be the upper 95th percent confidence limit on the appropriate mean or maximum likelihood estimate In calculating the media concentrations, censored data (data sets with missing values, non-detects, etc) will be treated by appropriate methods such as those described in Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987)

8 3 6 Contaminant Intake Estimation

In general, chemical intakes will be estimated using available, region-specific exposure parameters Deviation from standard parameters will be documented and submitted to the regional EPA office for approval prior to preparation of the risk assessment

Contaminant exposure (or intake) is normalized for time and body weight and is expressed as milligrams of contaminant per kilogram of body weight per day (mg/kg/day). Radionuclide intake is based on total activity and is expressed as picoCuries of radionuclide (pCi) Six basic factors are used to estimate intake exposure frequency, exposure duration, contact rate, chemical concentrations, body weight, and averaging time These factors are based on the types of exposure (e g , residential or occupational, ingestion, or inhalation)

The RME and average exposure point concentrations are used in conjunction with receptor activity patterns to estimate contaminant intake for each exposure route as appropriate. EPA requires using 95th percentile rates, 90th or 95th percentile values for exposure duration, and average values for parameters such as body weight For example, a residential land use scenario describes an adult, weighing 70 kilograms, who works at home and consumes 2 liters of water and breathes 20 cubic meters (m^3) of air per day The individual stays at home 350 days per year and lives in the same residence for 30 years Different parameters are used for children, adult workers, and recreational exposures based on information provided by EPA in the Risk Assessment Guidance for Superfund, Volume I Human Health Evaluation Manual Supplemental Guidance, "Standard Default Exposure Factors," Interim Final, March 25, 1991 (EPA, 1989c) Also, the averaging time for carcinogens and non-carcinogens differ

Other standard intake rates established by EPA that will be used, if appropriate, include the following:

- Soil ingestion rates for children ages 1 through 6
- Soil ingestion rates for all others (workers and residents more than 6 years of age)
- Inhalation rates based on activity levels

Contaminant rates can also be estimated for dermal exposures Of the three routes of exposure (ingestion, inhalation, and dermal), the greatest uncertainty is associated with dermal exposures. Part of this uncertainty results from the lack of chemical-specific permeability constants The Human Health Risk Assessment will calculate the estimated contaminant intake through dermal exposures and compare the intake values to those calculated for ingestion as the basis for demonstrating the significance of the dermal route relative to other routes of exposure

Human intake of COCs will be estimated using reasonable estimates of exposure parameters EPA guidance, site-specific factors, and professional judgement will be applied in establishing exposure assumptions Using reasonable values allows estimation of risks associated with the assumed exposure conditions without underestimating actual risk

Depending on the data collected and the refinement of the conceptual site model, nontraditional exposure routes that may be included in the Human Health Risk Assessment, include fish ingestion and exposures resulting from recreational uses of the reservoirs (contact with sediments, ingestion, and dermal contact with surface water) and the nearby open spaces (hiking, bicycling).

Other nontraditional exposure routes may be identified by using lad use data for the OU9 area These include exposure scenarios related to agricultural land uses and other recreational land uses within the OU9 area.

8 3 7 Uncertainty in the Exposure Assessment

The ability to construct exposure scenarios for a site depends on the amounts and kinds of environmental data collected for that purpose Some uncertainty is inherent in environmental data collection The numbers and kinds of uncertainties included in the exposure assessment directly impact the risk characterization; many professional judgements impact the identification and description of physical site attributes that affect exposure and activity patterns One of the major areas of uncertainty in the exposure assessment is the prediction of human activities that lead to contact with environmental media and exposures to site-related contaminants This section of the Human Health Risk Assessment will identify and describe how site attributes related to environmental sampling and analysis, fate and transport modeling, and exposure parameter estimation and assumptions about them affect uncertainty relative to assessing risk The exposure assessment uncertainty analysis will discuss the potential magnitude of over- or under-estimation, or both, provides an indication of the impact, by orders of magnitude, the uncertainty imparts on the estimation of risk

The uncertainty analysis will identify and evaluate non-site-specific and site-specific factors that may produce uncertainty in the risk assessment, such as assumptions inherent to development of toxicological endpoints (potency factors, reference doses) and assumptions considered in the exposure assessment (model input variability, population dynamics) Statistical simulation techniques (such as Monte-Carlo) may be employed for contaminants for which quantitative evaluation is possible The goal of this task will be to quantify, to the extent practicable, the uncertainty propagated through the risk assessment process. The uncertainty analysis will present the spectrum of potential risks under specified scenarios such that the risk management decision maker can obtain an understanding of the level of confidence associated with all estimates of potential human health risk

8 4 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to describe the contaminants considered in the Human Health Risk Assessment relative to their potential to cause harm The toxicity assessment has two general steps. The first determines what adverse health impacts, if any, could result from exposure to a particular contaminant These are typically classified as carcinogenic and non-carcinogenic health effects The second step, dose-response evaluation, quantitatively examines the relationship between the level of exposure and the incidence of adverse health effects

Toxicity depends on the dose or concentration of the substance (dose-response relationship). Toxicity values are a quantitative expression of the does-response relationship for a contaminant and take the form of RfDs and cancer slope factors, both of which are specific to exposure via different routes

Two sources of toxicity values are currently available for chemicals and radionuclides The primary source is the EPA's Integrated Risk Information System (IRIS) database IRIS contains up-to-date health risk and regulatory information IRIS contains only those RfDs and slope factors that have been verified by the EPA work groups and is considered by EPA to be the preferred source of toxicity information for chemicals

Following IRIS, the most recently available Health Effects Assessment Summary Tables (HEAST), issued by the EPA's Office of Research and Development, will be consulted to identify interim RfDs and slope factors for radionuclides

In addition to identifying appropriate toxicity values, this section of the Human Health Risk Assessment will provide brief toxicity profiles based on recent, published literature for each contaminant evaluated in the Human Health Risk Assessment These profiles will describe the acute, chronic, and carcinogenic health effects associated with site-related contaminants identified in OU9. Acute and chronic exposure to site-related radionuclides will be discussed, but most of the information presented will deal with the carcinogenic hazard posed by the site-specific radionuclides

8 4 1 <u>Uncertainty In Toxicity Assessment</u>

A summary of the uncertainty inherent in the toxicity values for the COCs shall be compiled and included in the Human Health Risk Assessment This summary shall include the following information.

- Qualitative hazard findings
  - potential for human toxicity
- Derivation of toxicity values
  - human or animal data
  - duration of study
- Potential for synergistic or antagonistic interaction with other substances
- Calculation of lifetime cancer risks on the basis of less than lifetime exposures

8 5 RISK CHARACTERIZATION

This section of the Human Health Risk Assessment presents the evaluation of potential risks to public health associated with exposure to contaminants at the OU9 site Potential carcinogenic and non-carcinogenic risks associated with complete exposure pathways will be estimated Risk characterization involves integrating exposure assumptions and toxicity information to quantitatively estimate the risk of adverse health effects Risk characterization will be performed in accordance with EPA guidance (EPA, 1989c)

Non-cancer risk will be assessed by comparing the estimated daily intake of a contaminant to its RfD This comparison measures the potential for non-carcinogenic health effects given the chemical intake factors used to estimate exposure. To assess the potential for non-cancer effects posed by multiple chemicals, EPA's hazard index approach will be used This method assumes dose additivity Hazard quotients (individual chemical intake divided by the chemical RfD) are summed to provide a hazard index, and if the index exceeds one, a potential for health risk is suggested If a hazard index exceeds one, where possible, chemicals may be segregated by similar effect or target organ to determine the potential health risks Separate hazard indexes may be derived for each effect if sufficient information or target organ specificity is available

The potential for carcinogenic effects will be estimated by calculating excess lifetime cancer risks from the lifetime average exposure and cancer slope factor These will be upper-bound estimates because methods used to estimate slope factors are regarded as upper bounds on potential cancer risks rather than accurate representations of true cancer risk

Both non-cancer and cancer risks will be estimated by using RME and average contaminant intake values combined with exposure assumptions This allows risk ranges to be considered rather than a single value and more closely considers the uncertainty associated with the estimates In addition, risks may be added across exposure routes to assess the potential for additive affects

Not all contaminants identified at OU9 will have toxicity values, thereby limiting the ability to develop quantitative estimates of risk Where adequate toxicity values cannot be identified, potential risks associated with exposure to those constituents will be dealt with qualitatively

8 5 1 Uncertainties in the Risk Characterization

The numbers and kinds of uncertainties identified in the Human Health Risk Assessment directly impact the interpretation of estimated risks developed in this section Quantitative risk estimates derived in risk assessments are conditional estimates that include numerous assumptions about exposures and toxicity Uncertainty is introduced from a variety of sources, including, but not limited, to the following sources

- Sampling and analysis
- Exposure estimation
- Toxicological data

As stated in the RAG (EPA, 1989c), a highly quantitative statistical uncertainty analysis is usually not practical or necessary for site risk assessments As in all environmental risk assessments, it is already known that the uncertainty about the numerical results is large. Consequently, it is more important to identify the key site related variables and assumptions that contribute most to the uncertainty than to precisely quantify the degree of uncertainty in the risk assessment

At a minimum, uncertainty will be described qualitatively in terms of under-or over-estimation of risk, or both If possible, uncertainty may be described quantitatively using sensitivity analyses or other numerical models

TABLE 8.1

EPA GUIDANCE DOCUMENTS WHICH MAY BE USED IN THE RISK ASSESSMENT TASK

EPA's Integrated Risk Information System (IRIS) — Office of Research and Development (continuously updated). Agency's primary source of chemical-specific toxicity and risk assessment information Includes narrative discussion of toxicity database quality and explains derivation of Reference Doses, cancer potency factors, and other key dose response parameters. IRIS presents information that updates data originally presented in Exhibits A-4 and A-6 of the SPHEM (see below) Further information IRIS Users Support, 513-569-7254 (EPA, 1987b)

Health Effects Assessment Summary Tables (HEAST) — Office of Research and Development/Office of Emergency and Remedial Response (updated quarterly). Because the IRIS chemical universe (while growing) is currently incomplete, the HEAST has been produced to serve as a "pointer" system to identify current literature and toxicity information on important non-IRIS chemicals. While HEAST data in some cases may be "Agency-verified," the information is considered valuable for Superfund risk assessment purposes Available from Superfund docket, 202-382-3046 (EPA, 1990b).

Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Supplemental Guidance — Office of Emergency and Remedial Response. This volume provides updated risk assessment procedures and policies, specific equations and variable values for estimating exposure, and a hierarchy of toxicity data sources There is an expanded chapter on risk characterization to help summarize information for the decision makers and detailed descriptions of uncertainties in risk assessment (EPA, 1989c)

OSWER Directive on Soil Ingestion Rates — Office of Solid Waste and Emergency Response (January 1989), OSWER Directive No 9850 4 Recommends soil investigation rates for use in risk assessment when site-specific information is not available Available from Darlene Williams, 202-475-9810 (EPA, 1989c).

Ecological Assessment of Hazardous Waste Sites A Field and Laboratory Reference — Office of Solid Waste and Emergency Response EPA 600-3/89/013 This report is a field and laboratory reference document that provides guidance on designing, implementing, and interpreting ecological assessments of hazardous waste sites It includes sections on ecological endpoints, field sampling design, quality assurance, aquatic and terrestrial toxicity and field survey methods, recommended biomarkers, and data analysis (EPA, 1989d).

Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual, Interim Final (RAGS-EEM) — Office of Emergency and Remedial Response (March 1989), EPA/540/1-89/002 Provides program guidance to help remedial project managers and on-scene coordinators manage ecological assessment at Superfund sites (EPA, 1989b)

TABLE 8.1

EPA GUIDANCE DOCUMENTS WHICH MAY BE USED IN THE RISK ASSESSMENT TASK
(Continued)

Exposure Factors Handbook — Office of Research and Development (March 1989), EPA/600/8-89/043. Provides statistical data on the various factors used in assessing exposure, recommends specific default values to be used when site-specific data are not available for certain exposure scenarios Further information. Exposure Methods Branch, 202-382-5988 (EPA, 1989e).

Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA — Office of Emergency and Remedial Response EPA/540/8-89/004 This guidance document is a revision of the EPA's 1985 guidance. It describes general procedures for conducting an RI/FS (EPA, 1988a)

Superfund Exposure Assessment Manual (SEAM) — Office of Emergency and Remedial Response (April 1988), EPA/540/1-88/001 Provides a framework for the assessment of exposure to contaminants at or migrating from hazardous waste sites Discusses modeling and monitoring* (EPA, 1988e)

CERCLA Compliance with Other Laws Manual — Office of Emergency and Remedial Response The guidance is intended to assist in the selection of on-site remedial actions that meet the ARARs of RCRA, Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Clean Air Act (CAA), and other federal and state environmental laws as required by CERCLA, Section 121 (EPA, 1988f)

Guidance for Data Useability in Risk Assessment — Interim Final, EPA/540/G-90/008 (EPA, 1990a).

Federal Guidance Report No 10 — The Radioactivity Concentration Guides -- Office of Radiation Programs (EPA, 1984) EPA/520/1-84/010

Federal Guidance Report No 11 — Limiting Values of radionuclide Intake and Air Concentration and Dose Conversion Factors for inhalation, Submersion, and Ingestion -- Office of Radiation Programs (EPA, 1988d) EPA/520/1-88/020

Approved By:

_____________________ __/__/__
Work Plan Manager (Date)

_____________________ __/__/__
Division Manager (Date)

Effective Date: ____________________

10.0 QUALITY ASSURANCE ADDENDUM

This section consists of the Quality Assurance Addendum (QAA) for Phase I investigations at Operable Unit No 9 (OU9), which supplements the "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPjP). This QAA establishes the site-specific Quality Assurance (QA) controls applicable to the investigation activities described in the OU9 Work Plan (OU9 WP)

OU9 is one of 16 OUs identified for investigations under the IAG OU9 consists of the OPWL, the various components of which are considered IHSS 121 IHSS 121 currently consists of 35,000 feet of underground pipelines and 65 tanks The area addressed by the OU9 Phase I RFI/RI includes areas in close proximity to the OPWL pipelines and tanks, and areas from which OPWL pipelines and tanks have been removed. The physical setting of OU9 is described in Section 2.0 and illustrated in Figure 2-1

The OU9 Phase I of the RFI/RI process involves characterization of the contaminant sources and the soils within the OU This includes sampling residue in tanks and pipelines and sampling of soils, which the OU9 WP has interpreted to include vadose zone (unsaturated) surficial deposits The OU9 WP has been prepared in accordance with the Federal and State of Colorado regulations and guidance documents identified in the Introduction (Section 1 0)

10.1 ORGANIZATION AND RESPONSIBILITIES

The overall organization of EG&G, the EMD, and divisions involved in ER Program activities is shown in Figures 1-1, 1-2, and 1-3 of Section 1.0 of the QAPjP Individual responsibilities are also described in Section 1 0 of the QAPjP

Contractors will be tasked by EG&G to implement the field activities outlined in the OU9 WP The specific EMD personnel who will interface with the Contractors and who will provide technical direction are shown in Figure 10-1

10 2 QUALITY ASSURANCE PROGRAM

The QAPjP was written to address QA controls and requirements for implementing IAG-related activities The content of the QAPjP was driven by Department of Energy (DOE) RFP Standard Operating Procedure (OP) 5700 6B, which requires a QA program to be implemented for all RFP activities This program is required to be developed based on American Society of Mechanical Engineers (ASME) NQA-1, "Quality Assurance Requirements for Nuclear Facilities," as well as the IAG, which specifies that a QAPjP for IAG-related activities be developed in accordance with the EPA QAMS-005/80, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans " The 18-element format of NQA-1 was selected as the basis for both the QAPjP and subsequent SAAs with the applicable elements of QAMS-005/80 incorporated where appropriate Figure 2-1 of the QAPjP illustrates where the 16 QA elements of QAMS-005/80 are integrated into the QAPjP and also into this QAA Section 2 0 of the QAPjP also identifies other DOE Orders and QA requirements documents to which the QAPjP and this QAA are responsive

The controls and requirements addressed in the QAPjP are applicable to OU9 Phase I RFI/RI activities, unless specified otherwise in this QAA Where site-wide actions are applicable to OU9 activities, the applicable section of the QAPjP is referenced in this QAA. This QAA addresses additional and site-specific QA controls and requirements that are applicable to OU9 Phase I activities that may not have been addressed on a site-wide basis in the QAPjP Many of the QA requirements specific to OU9 are addressed in the OU9 WP and are referenced in this QAA.

10 2 1 Training

Personnel qualification and training requirements for RFP ER Program activities are addressed in Section 2.0 of the QAPjP. Personnel qualifications and training required to perform the EMD OPs that are applicable to OU9 investigations are specified within the respective procedures The EMD OPs (which are also referred to as OPs in the QAPjP and the OU9 WP) are identified in Table 10.1

10 2 2 Quality Assurance Reports to Management

A QA summary report will be prepared annually or at the conclusion of these activities (whichever is more frequent) by the EMD Quality Assurance Project Manager (QAPM) or designee This report will include a summary of field operation and laboratory inspections, surveillance, and audits and a report on data verification/validation results

10 3 DESIGN CONTROL AND CONTROL OF SCIENTIFIC INVESTIGATIONS

10 3 1 Design Control

Section 7 describes the Phase I investigation activities that will be implemented to characterize the physical features of the site and define the contaminant sources at OU9 A summary of Phase I RFI/RI activities to be conducted at OU9 is presented in Table 7 2 Section 9 describes the EE activities to be conducted to characterize the biotic environment and address and quantify the ecological effects from exposure to contaminants within OU9 The OU9 WP identifies the objectives of the investigations, specifies the sampling, analysis, and data generation requirements; and identifies applicable operating procedures that will provide controls for the investigations As such, the OU9 WP is considered the investigation control plan for OU9 Phase I RFI/RI activities

10 3 2 Data Quality Objectives

Data needs and DQOs for OU9 Phase I investigations are addressed in Section 4 0, and Section 9 2.1 for the EE data The DQOs for the OU9 Phase I investigations were established in accordance with EPA guidance for developing DQOs, which is summarized in Appendix A of the QAPjP.

The specific objectives, or data needs, of the OU9 Phase I RFI/RI are based on existing site information regarding the nature of contamination present and the preliminary site-specific conceptual model for OU9 These specific objectives determine the type of data to be collected. The quality of the data is dependent on the analytical level of the data, which dictates the type of sampling and analytical or measurement quality controls that should be adhered to in generating the data. The EPA has defined five levels of analytical data (Levels I - IV) These analytical levels are defined in Section 4 0 and Appendix A of the QAPjP Level I or II analytical or measurement data requires less QC than does Level II - V quantitative analytical data, which is of a known quality

The intended use of the data determines which analytical level is required for the RFI/RI data to be generated. The type of data that needs to be generated and the analytical level of the data together determine the sampling and analytical or measurement options to be employed to generate measurement data appropriate for its intended use The data needs, data types, sampling and analysis activities, analytical levels, and data use for the OU9 Phase I RFI/RI are identified in Table 4.1.

Data quality can be measured in terms of PARCC parameters These parameters are defined in Appendix A of the QAPjP PARCC parameter goals are established prior to initiating investigations in order to assist decision makers in determining if DQOs for measurement data have been met.

PARCC parameter goals for measurement data are established so that they are appropriate to the analytical level of the data Analytical Level IV and V data require analysis of environmental samples by EPA approved methods and adherence to QC requirements that are specified by the EPA CLP Historical precision and accuracy measures for EPA CLP analytical and equivalent methods have been determined These historical measures have been selected as the precision and accuracy goals for all OU9 analytical IV and V data These historical precision and accuracy measures for soil materials are listed in Appendix B of the QAPjP These same goals are also applicable to the analysis of materials collected from pipelines and tanks If any material from pipelines and tanks consist of a liquid matrix, the precision and accuracy goals for water samples are applicable

Accuracy goals for field parameters (i e., wipe samples from OPWL pipelines and tanks) to be measured during Phase I investigations (analytical Level II data, which consists of field analysis or measurements using portable equipment) consist of adhering to approved operating procedures for sampling and analysis, including following applicable instrument calibration requirements

Goals for representativeness, comparability, and completeness for the OU9 Phase I RFI/RI are specified in Section 4 2 6

The ecological characterization activities described in Section 9.0 are considered screening activities that, typically, require Analytical Level I and II data These characterization data will then be used, along with the OU9 RFI/RI characterization and source contamination data, to develop the conceptual model for the EE study Data quality for these characterization activities will be controlled by adhering to the field sampling operating procedures for EEs listed in Table 1 and implementing the EE Field Sampling Plan (Section 9 3)

The conceptual model developed for the OU9 ecosystem will then assist investigators in identifying site-specific target species, contaminants of concern, and potential exposure pathways Additional DQOs for the contamination assessment tasks (Tasks 4 through 7 of Section 9) and the ecotoxicological studies (Task 8) will then be developed following steps recommended by the EPA in EPA/600/3-89/013, Ecological Assessments of Hazardous Waste Sites A Field Guide and Laboratory Reference Document, and EPA/540/G-90/008, Guidance for Data Usability in Risk Assessment The ecosystem characterization data and preliminary aquatic toxicity investigation data that will be obtained by implementing the EE Field Sampling Plan are needed to develop these additional DQOs

10 3 3 Sampling Locations and Sampling Procedures

The sampling rationale for the OU9 Phase I RFI/RI is based on an interactive process Stage 1 sampling is designed to detect points of contamination in OU9 soils using the release scenarios developed in the conceptual model presented in Section 2 5 Stage 2 sampling activities are designed to provide a preliminary assessment of the extent of contamination present in OU9 Locations of contamination identified by analytical results from Stage 1 will be investigated further by sampling on a grid pattern to delineate the contaminant plume

The field sampling design, including sampling locations, frequencies, methods, and procedures are described in Section 7 3 Sampling locations, frequencies, and procedures for the EE program, consisting of vegetation, small mammals, and arthropods sampling are addressed in Section 9.3.

The operating procedures that are applicable to OU9 Phase I field activities and the particular activities to which they are applicable are summarized in Table 10.1.

10 3 4 Analytical Procedures

The analytical program for the OU9 Phase I RFI/RI is discussed in Section 7 4. The analyses of soil and residue samples collected from Stage 1 sampling is specified in Section 7 4.1 and listed in Table 7 2 Wipe samples from pipelines and tanks will be screened in the field for radionuclide contamination according to OP-FO.16, Field Radiological Measurements, which will provide a qualitative measure of radionuclide contamination The analytical methods and specified detection/quantitation limits for the analysis of Stage 1 samples are specified in Appendix B of the QAPjP Analytes of interest for Stage 2 sampling will be based on results of Stage 1 samples

10 3.5 Equipment Decontamination

Non-dedicated sampling equipment (i e , sampling equipment that is used at more than one location) shall be decontaminated between sampling locations in accordance with OP-FO 03, General Equipment Decontamination Other equipment (e g., heavy equipment) potentially contaminated during drilling, hydrogeologic/geologic testing, boring, sample collection, etc., shall also be decontaminated as specified in OP-FO-04, Heavy Equipment Decontamination

10.3.6 Air Quality

Air monitoring will be conducted during implementation of field activities that have the potential to create windblown dispersion of contaminants, including drilling, coring, and installation of monitoring wells. Air monitoring will ensure that OU9 RFI/RI activities comply with the RFP Interim Plan for Prevention of Contamination Dispersion. Air monitoring will be conducted according to OP-FO 01, Wind Blown Contaminant Dispersion Control

10 3 7 Quality Control

To ensure the quality of the field sampling techniques, collection and/or preparation of field quality control (QC) samples are incorporated into the sampling scheme Field QC samples and collection frequencies for OU9 are addressed in Section 7.6 and identified in Table 7.5 A specific sampling schedule will be prepared by the sampling subcontractor for approval by the EG&G Laboratory Analysis Task Leader (Figure 10-1) prior to sampling.

10.3 7 1 Objectives for Field QC Samples

Equipment rinsate blanks are considered acceptable (with no need for data qualification) if the concentration of analytes of interest is less than three times the required detection limit for each analyte as specified in Table 7 1. Field duplicate samples shall agree within 30 percent relative percent difference for aqueous samples and 40 percent for homogenous, non-aqueous samples.

Trip blanks and field preservation blanks (for organics and inorganics, respectively) indicate possible field contamination when analytes are detected above the minimum detection limits presented in Table 7 1 The Laboratory Analysis Task Leader (Figure 10-1) is responsible for verifying these criteria and shall be responsible for checking to see if they are met and for qualifying data.

10 3.7 2 Laboratory Quality Control

Laboratory QC procedures are used to provide measures of internal consistency of analytical and storage procedures The laboratory contractor will submit written OPs to the Laboratory Analysis Task Leader for approval The inter-laboratory OPs shall be consistent with or equivalent to EPA-

CLP QC procedures The laboratory OPs must cover the following areas in sufficient detail and reflect actual operating conditions in effect during analysis of EG&G samples:

- Sample receipt and log-in
- Sample storage and security
- Facility security
- Sample tracking (from receipt to sample disposition)
- Sample analysis method references
- Data reduction, verification, and reporting
- Document control (including submitting documents to EG&G)
- Data package assembly (see Section III A of the GRRASP)
- Qualifications of personnel
- Preparation of standards
- Equipment maintenance and calibration
- List of instrumentation and equipment (including date purchased, date installed, model number, manufacturer, and service contracts, if any)
- Instrument detection limits
- Acceptance criteria for non-CLP analyses
- Laboratory QC checks applicable to each analytical method

Laboratory QC techniques to ensure consistency and validity of analytical results (including detecting potential laboratory contamination of samples) include using reagent blanks, field blanks, internal standard reference materials, laboratory replicate analysis, and field duplicates The laboratory contractor will follow the standard evaluation guidelines and QC procedures, including frequency of QC checks, that are applicable to the particular type of analytical method being used as specified in Parts A and B of the GRRASP and Section 3 0 of the QAPjP All data packages will be forwarded to the Laboratory Analysis Task Leader or validation contractor (Figure 10-1) for review and verification

10.3 8 Quality Assurance Monitoring

To assure the overall quality of the RFI/RI activities discussed in the OU9 WP, field inspections will be conducted daily and audits and surveillance will be conducted at various intervals The intervals will be determined by the importance and complexity of each activity Intervals will also be based on the schedule contained in Section 6 0 At a minimum, each of the field sampling activities described in Sections 7 3 and 9 3 will be monitored by an independent surveillance team at least once during the sampling process EG&G will conduct audits of the laboratory contractor(s) as specified in the GRRASP, Parts A and B The audits and surveillance, and activity Readiness Reviews are discussed further in Section 10 18

10 3 9 Data Reduction, Validation, and Reporting

10 3 9 1 Analytical Reporting Turnaround Times

Analytical reporting turnaround times are as specified in Table 3-1 of Section 3 0 of the QAPjP.

10 3 9 2 Data Reduction

Reduction of laboratory measurements shall be in accordance with the procedures specified for each analytical method. Laboratory data will be compiled into sample data packages by the laboratory contractor A sample data package shall be developed for each sample delivery group or sample batch, with separate data packages for each type of analysis (e g , a data package for organics, one for inorganics, one for water quality parameters, and one for radionuclides) The sample data package shall consist of a cover sheet/transmittal letter, a case narrative, data summary forms, and copies of the data checklists found in Attachment I in Parts A and B of the GRRASP The reduced data will be used in the data validation process to verify that the laboratory control and overall system DQOs have been met

10 3 9 3 Data Validation

Validation activities consist of reviewing and verifying field and laboratory data and evaluating these verified data for data quality (i e , comparison of reduced data to DQOs, where appropriate). The field and laboratory data validation activities and guidelines are described and referenced in Section 3.0 of the QAPjP The process for validating the quality of the data is illustrated graphically in Figure 3-1 of Section 3 0 of the QAPjP, and is also included as part of the sample collection, chain-of-custody, and analysis process illustrated in Figure 8-1 of Section 8 0 of the QAPjP The criteria for determining the validity of ER Program data at Rocky Flats are described in subsection 3 3 7 of Section 3 0 of the QAPjP

10 3 9 4 Data Management and Reporting

Data management and reporting requirements are specified in Section 7.5

10 4 PROCUREMENT DOCUMENT CONTROL

Procurement documents for items and services, including services for conducting field investigations and analytical laboratories, shall be prepared, handled, and controlled in accordance with the requirements and methods specified in Section 4 0 of the QAPjP

10 5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

The OU9 WP describes the activities to be performed The OU9 WP will be reviewed and approved in accordance with the requirements for instructions, procedures, and drawings outlined in Section 5.0 of the QAPjP

EMD OPs approved for use are identified in Table 10 1, which also indicates their applicability. Any additional quality-affecting procedures proposed for use but not identified in Table 10.1 will be developed and approved as required by Section 5 0 of the QAPjP prior to performing the affected activity

Changes and variances to approved operating procedures and the OU9 WP shall be documented through preparation of Document Change Notices (DCNs), which will be prepared, reviewed, and approved in accordance with requirements specified in Section 5 0 of the QAPjP. (Note· DCNs were referred to as Procedure Change Notices in Revision 0 of the QAPjP.)

10 6 DOCUMENT CONTROL

The following documents will be controlled in accordance with Section 6 0 of the QAPjP.

- "Phase I RFI/RI Work Plan for Rocky Flats Plant Original Process Waste Lines (Operable Unit No 9)"
- "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPjP)
- EMD Operating Procedures (all operating procedures specified in the QAPjP, this QAA, and to-be-developed laboratory OPs).

10 7 CONTROL OF PURCHASED ITEMS AND SERVICES

Contractors that provide services to support the OU9 WP activities will be selected and evaluated as outlined in Section 7 0 of the QAPjP This includes preaward evaluation/audit of proposed contractors as well as periodic audit of the acceptability of contractor performance during the life of the contract Any items or materials that are purchased for use during the OU9 investigations that have the ability to affect the quality of the data shall be inspected upon receipt

10 8 IDENTIFICATION AND CONTROL OF ITEMS, SAMPLES, AND DATA

10 8 1 Sample Containers/Preservation

Appropriate volumes, containers, preservation requirements, and holding times for soil and residue samples are presented in Table 7 4 Requirements for EE samples collected for tissue analyses are included in Table 10 2

10.8.2 Sample Identification

RFI/RI samples shall be labeled and identified in accordance with Section 8 0 of the QAPjP and OP-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples. Samples shall have unique identification that traces the sample to the source(s) and indicates the method(s), date, the sampler(s), and conditions prevailing at the time of sampling.

10 8 3 Chain-of-Custody

Sample chain-of-custody will be maintained through the application of OPS-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples, and as illustrated in Figure 8-1 of the QAPjP for all environmental samples collected during field investigations.

10 9 CONTROL OF PROCESSES

The overall process of collecting samples, performing analysis, and inputting the data into a database is considered a process that requires control The process is controlled through a series of written procedures that govern and document the work activities A process diagram is shown in Section 8 0 of the QAPjP.

10 10 INSPECTION

Procured materials and construction activities (e g , groundwater monitoring well installation) shall be inspected (as applicable) in accordance with the requirements specified in Section 10.0 of the QAPjP

10 11 TEST CONTROL

Test control requirements specified in Section 11.0 of the QAPjP are not applicable to any of the RFI/RI investigations described in the OU9 WP

10 12 CONTROL OF MEASURING AND TEST EQUIPMENT (M&TE)

10 12 1 Field Equipment

Field measurements for radiation will be made with the following instrument

- Radiological field readings for pipe and tank swipes and drill cuttings, core, and samples A side-shielded field instrument for detection of low energy radiation (FIDLER), Ludlum Model 12-1A or equivalent

Each piece of field equipment shall have a file that contains:

- Specific model and instrument serial number
- Operating instructions
- Routine preventative maintenance procedures, including a list of critical spare parts to be provided or available in the field
- Calibration methods, frequency, and description of the calibration solutions
- Standardization procedures (traceability to nationally recognized standards).

10 12 2 Laboratory Equipment

Laboratory analyses will be performed by contracted laboratories The equipment used to analyze environmental samples shall be calibrated, maintained, and controlled in accordance with the requirements contained in the specific analytical protocols used as specified in Parts A and B of the GRRASP This information will be supplied to EG&G as a laboratory OP

10 13 HANDLING, STORAGE, AND SHIPPING

Samples shall be packaged, transported, and stored in accordance with OP-FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples Maximum sample holding times, sample preservative, sample volumes, and sample containers are specified in table 8-1 of Section 8.0 of the QAPjP Sample handling and storage controls at the laboratory shall be provided as a laboratory OP

10 14 STATUS OF INSPECTION, TEST, AND OPERATIONS

The requirements for the identification of inspection, test, and operating status shall be implemented as specified in Section 14 0 of the QAPjP A log specifying the status of all boreholes shall be maintained by the Field Activities Task Leader, which will include borehole identification number, ground elevation, casing depth of hole, depth to bedrock, static water level (as applicable), diameter of hole, diameter of casing, and top/bottom of casing

10 15 CONTROL OF NON-CONFORMANCES

The requirements for identification, control, evaluation, and disposition of nonconforming items, samples, and data will be implemented as specified in Section 15.0 of the QAPjP Non-conformances identified by the implementing contractor shall be submitted to EG&G for processing as outlined in the QAPjP

10 16 CORRECTIVE ACTION

The requirements for the identification, documentation, and verification of corrective actions for conditions adverse to quality will be implemented as outlined in Section 16.0 of the QAPjP. Conditions adverse to quality identified by the implementing contractor shall be documented and submitted to EG&G for processing as outlined in the QAPjP

10 17 QUALITY ASSURANCE RECORDS

QA records will be controlled in accordance with OP-FO 02, Field Document Control QA records to be generated during OU9 RFI/RI Phase I activities include, but are not limited to·

- Results of data compilation from review of existing information
- Record of tactical assessment
- Records of interviews and record searches
- Field Logs and Data Record Forms (e g , sample collection notebooks/logs for water, sediment, and air)
- Calibration Records
- Sample Collection and Chain-of-Custody Records
- Laboratory Sample Data Packages
- Drilling Logs

- Work Plan/Field Sampling Plan/QAA
- QAPjP
- Audit/Surveillance/Inspection Reports
- Nonconformance Reports
- Corrective Action Documentation
- Data Validation Results
- Data Reports
- Procurement/Contracting Documentation
- Training/Qualification Records
- Inspection Records

10 18 QUALITY VERIFICATION

The requirements for the verification of quality shall be implemented as specified in Section 18 or the QAPjP. EG&G will conduct audits of the laboratory contractor as specified in the GRRASP, Parts A and B. The EMD QAPM shall develop a surveillance schedule with the surveillance intervals based on the importance and complexity of each sampling/analytical activity. Intervals will also be based on the schedule contained in Section 6 0

Examples of some specific tasks that will be monitored by the surveillance program are as follows·

- Bore holes (approximately 10 percent of the holes)
- Field sampling (approximately 5 percent of each type of sample collected)
- Records management (a surveillance will be conducted once at the initiation of OU9 activities, and monthly thereafter)
- Data verification, validation, and reporting

Audits of contractors providing field investigation, construction, and analytical support services shall be performed at least annually or once during the life of the project, whichever is more frequent.

A Readiness Review shall be conducted by the EMD QAPM prior to the implementation of OU9 field investigation activities The readiness review will determine if all activity prerequisites have been met that are required to begin work The applicable requirements of the QAPjP and this QAA will be addressed

10 19 SOFTWARE CONTROL

The requirements for the control of software shall be implemented as specified in Section 19.0 of the QAPjP Only database software is anticipated to be used for the OU9 WP activities. Operating procedures applicable to the use of the database storing environmental data can be found in OP-FO.14, Field Data Management

TABLE 10.1
EMD Operating Procedures and Field Activities for Which They are Applicable

Former SOP Reference Number	EMD OPS Reference Number	Operating Procedures	Residue Sampling	Subsurface Soil Sampling	Surface Soil Sampling	Biota Sampling
1.1	F0.01	Wind Blown Contaminant Dispersion Control		●		
1.2	F0.02	Field Document Control	●	●	●	●
1.3	F0.03	General Equipment Decontamination	●	●	●	●
1.4	F0.04	Heavy Equipment Decontamination		●		●
1.5	F0.05	Handling of Purge and Development Water		●		
1.6	F0.06	Handling of Personal Protective Equipment	●	●	●	●
1.7	F0.07	Handling of Decontamination Water & Wash Water	●	●	●	●
1.8	F0.08	Handling of Drilling Fluids & Cuttings		●		
1.9	F0.09	Handling of Residual Samples	●		●	●
1.10	F0.10	Receiving, Labeling, and Handling Waste Containers		●		●
1.11	F0.11	Field Communications	●	●	●	●
1.12	F0.12	Decontamination Facility Operations	●	●	●	●
1.13	F0.13	Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples	●	●	●	●
1.14	F0.14	Field Data Management	●	●	●	●
1.15	F0.15	Use of PIDs and FIDs	X	X	X	X
1.16	F0.16	Field Radiological Measurements	●	X	X	X
New	FO.18	Environmental Sample Radioactivity Content Screening	●	●	●	
New	FO.21	Protection of Threatened and Endangered and Special Concern Species				●

X - As required by H&S plan.

TABLE 10.1 (Continued)
EMD Operating Procedures and Field Activities for Which They are Applicable

Former SOP Reference Number	EMD OPS Reference Number	Operating Procedures	Residue Sampling	Subsurface Soil Sampling	Surface Soil Sampling	Biota Samples
3.1	GT 01	Logging Alluvial and Bedrock Material		●		
3.2	GT 02	Drilling and Sampling Using Hollow-Stem Auger Techniques		●		
3.3	GT 03	Isolating Bedrock from the Alluvium with Surface Casing				
3.4	GT 04	Rotary Drilling and Rock Coring				
3.5	GT 05	Plugging and Abandonment of Boreholes		●		
3.6	GT 06	Monitoring Well and Piezometer Installation				
3.7	GT 07	Logging and Sampling of Test Pits and Trenches		●		
3.8	GT 08	Surface Soil Sampling			●	
3.10	GT 10	Borehole Clearing				
New	GT 17	Land Surveying			●	
New	TBD	Residue Sampling in Pipelines and Tanks	●			
5.8	EE.08	Sampling of Small Mammals				●
5.9	EE.09	Sampling of Terrestrial Arthropods				●
5.10	EE.10	Sampling of Terrestrial Vegetation				●
5.11	EE.11	Identification of Habitat Types				●
5.12	EE.12	Sampling of Soil for Soil Description				●
5.13	EE.13	Development of Field Sampling Plans				●

TABLE 10.2

HOLDING TIMES, PRESERVATION METHODS, AND SAMPLE CONTAINERS FOR BIOTA SAMPLES

	Holding Time from Date Collected	Preservation Method	Container	Approximate Sample Size[1]
Samples for Metals Analyses Terrestrial Vegetation				
Metals determined by ICP[2]	6 months	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	25 g
Metals determined by GFAA[3]	6 months	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	25 g
Hexavalent chromium	24 hours	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	25 g
Mercury	28 days	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	5 g
Samples for Radionuclide Analyses Terrestrial Vegetation				
Uranium 223, 234, 235, 238 Americium 241 Plutonium 239, 240	6 months	Freeze & ship w/dry ice	Paper bag inserted into plastic bag and sealed	1 kg

[1] Sample size may vary with specific laboratory requirements.
[2] ICP = Inductively Coupled Argon Plasma Emission Spectroscopy. Metals to be determined include Ba, Cr, Cu, and Fe
[3] GFAA = Graphite Furnace Atomic Absorption Spectroscopy Metals to be determined include As, Cd, Li, Pb, Se, and Sr

Approved By

______________________ __/__/__
Work Plan Manager (Date)

______________________ __/__/__
Division Manager (Date)

Effective Date. ______________________

11.0 ENVIRONMENTAL MANAGEMENT DIVISION OPERATING PROCEDURES

The following EMD program-wide OPs will be utilized during the specific field investigations for OU9.

- FO 1 Windblown Contaminant Dispersion Control
- FO 2 Field Document Control
- FO 3 General Equipment Decontamination
- FO.4 Heavy Equipment Decontamination
- FO 5 Handling Purge and Development Water
- FO 6 Handling of Personal Protective Equipment
- FO.7 Handling of Decontamination Water and Wash Water
- FO.8 Handling of Drilling Fluids and Cuttings
- FO.9 Handling of Residual Samples
- FO 10 Receiving, Labeling, and Handling Environmental Materials Containers
- FO.11 Field Communications
- FO.12 Decontamination Facility Operations
- FO 13 Containerizing, Preserving, Handling, and Shipping Soil and Water Samples
- FO 14 Field Data Management
- FO.15 Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs)
- FO.16 Field Radiological Measurements
- FO.18 Environmental Sample Radioactivity Content Screening
- FO 21 Protection of Threatened and Endangered and Special Concern Species
- GT 1 Logging Alluvial and Bedrock Material
- GT 2 Drilling and Sampling Using Hollow-Stem Auger Techniques
- GT 5 Plugging and Abandonment of Boreholes
- GT 7 Logging and Sampling of Test Pits and Trenches
- GT 8 Surface Soil Sampling
- GT 10 Borehole Clearing
- GT 17 Land Surveying

- SW.2 Field Measurements of Surface Water Field Parameters
- SW 3 Surface Water Sampling
- SW.6 Sediment Sampling
- EE 6 Sampling of Small Mammals
- EE.9 Sampling of Terrestrial Arthropods
- EE 10 Sampling of Terrestrial Vegetation
- EE 11 Identification of Habitat Types
- EE 12 Sampling of Soil for Soil Description
- EE 13 Development of Field Sampling Plans

Specific information regarding most sampling activities is provided in the FSP (Section 7 0). Project-specific details for this Work Plan will be included in DCNs or OP revisions. These revisions will be attached to the OP for use during field activities

11 1 REVISION TO OP GT 3, LOGGING AND SAMPLING OF TEST PITS AND TRENCHES; PIPELINE RESIDUE SAMPLING

The pipelines will be inspected for remaining inventory and, if possible, a residue sample will be collected to characterize OPWL wastes Pipeline sampling will employ invasive techniques and will be performed during pipeline inspection activities Where practical, the pipeline will be opened at each test pit location and at valves and cleanouts for pipe inspection Test pit sampling is discussed in detail in Section 7 3.1 1

The pipe will either be cut open or dismantled at each inspection location. The pipe will be checked for fluids before cutting by drilling a hole into the top This will be accomplished by encasing the pipe with a rubber saddle, and drilling through the pipe wall with a valved tap Control of any remaining fluids will be maintained with the saddle and valve assembly To cut the pipe and collect any inventory without spillage, a small catch basin will be designed to fit around the pipe The test pit will be covered with a synthetic liner as secondary containment Any inventory which is removed from the line in excess of sampling requirements will be managed in accordance with site procedures in the Part B Permit Applications

If any waste material remains in the pipes where they are opened, the material will be sampled, if possible, and analyzed for the Phase I analytical parameters (Table 7.1). Material remaining in pipelines may be sampled by (1) collecting drained liquids, (2) scraping with custom-made tools, (3) suctioning, or (4) other methods spelled out in technical memoranda and approved by DOE, EPA, and CDH Pipe sections which are cut will be grouted closed with a plug of non-shrinking cement

11 2 REVISION TO OP SW 6, SEDIMENT SAMPLING; TANK RESIDUE SAMPLING

Tanks will be inspected for remaining inventory and, if possible, a residue sample will be collected to characterize OPWL wastes Tank sampling will be performed during tank inspection activities (Section 7.3 2 1). If possible, all tank sampling will be conducted remotely to minimize health and safety concerns

Remaining waste material residue may consist of liquids, free-flowing slurries, sludges, and scale material Sampling equipment and technique will depend upon the type of material(s) encountered No horizontal stratification will be assumed although vertical anomalies and heterogeneity due to settling of suspended solids or denser liquid phases is likely Therefore, if possible, one representative composite sample of the remaining waste material will be collected for each tank and analyzed for the Phase I analytical parameters (Table 7 1)

Liquids and free-flowing slurries may be sampled using the following equipment (EPA, 1986):

- Composite Liquid Waste Sampler (Coliwasa) The coliwasa consists of a glass, plastic, or metal tube equipped with an end enclosure that can be opened and closed while the tube is submerged in the material to be sampled

- Weighted Bottle: The weighted bottle consists of a glass or plastic bottle, sinker, stopper, and line that is used to lower, raise, and open the bottle

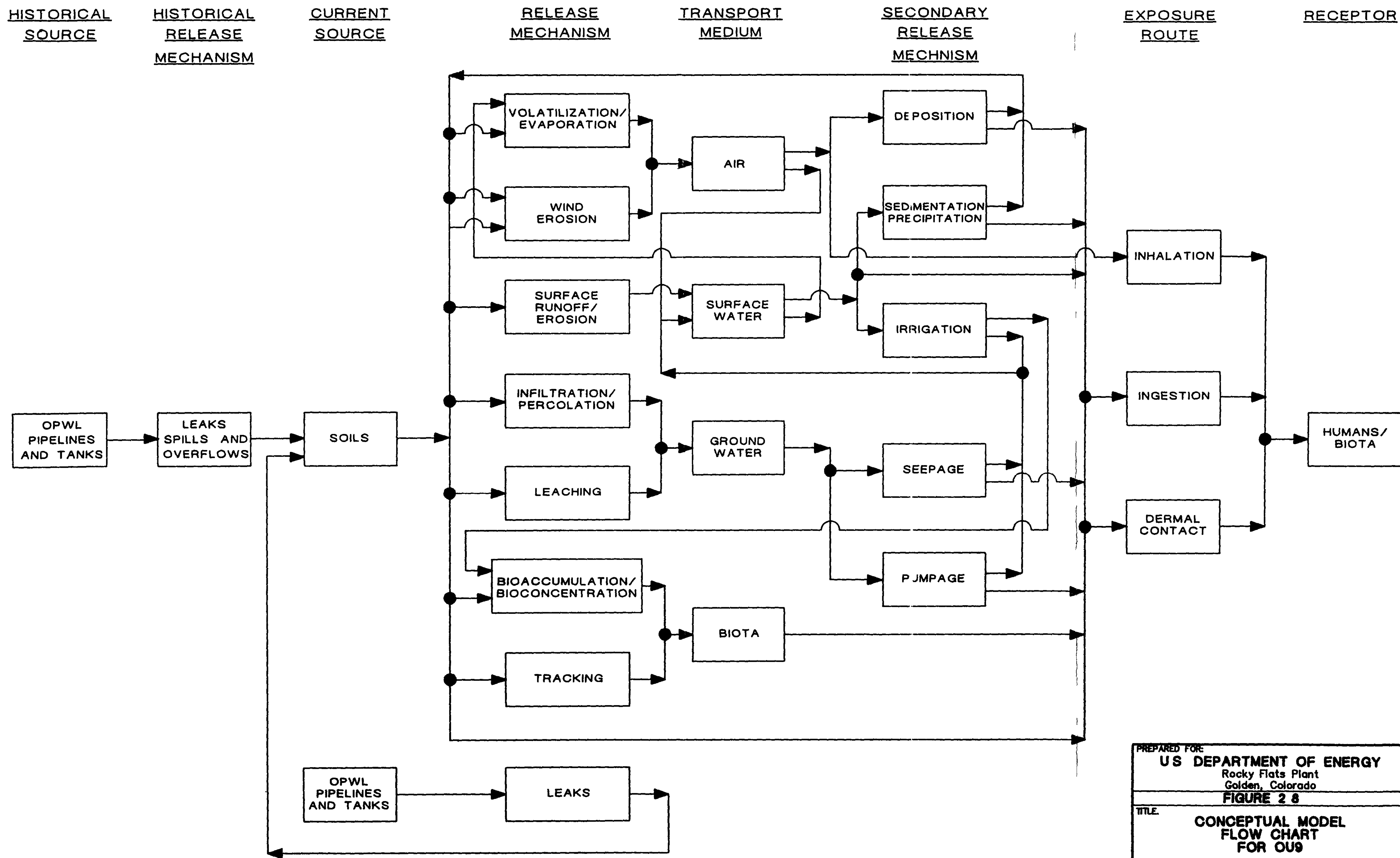
- Bailer Well bailers can be lowered on cables into tanks to sample free liquids

Sludges may be sampled using the following equipment (EPA, 1986)

- Trier. A trier consists of a tube cut in half lengthwise with a sharpened tip that can cut into sticky solids

- Scoops and Shovels. Scoops and shovels can be employed to sample sludges.

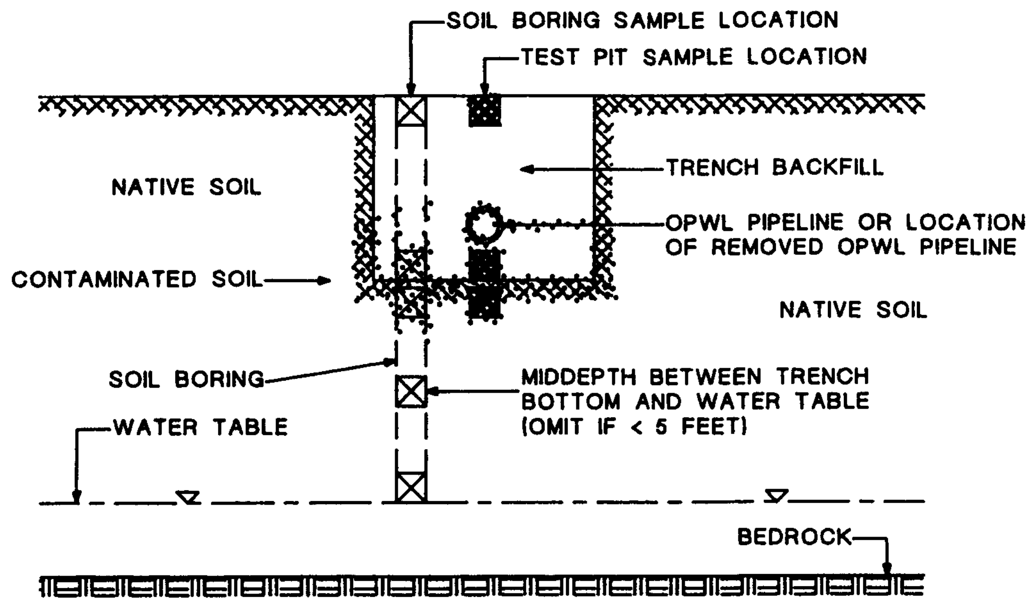
These devices may be fabricated or modified to various lengths to facilitate remote sampling of the tanks



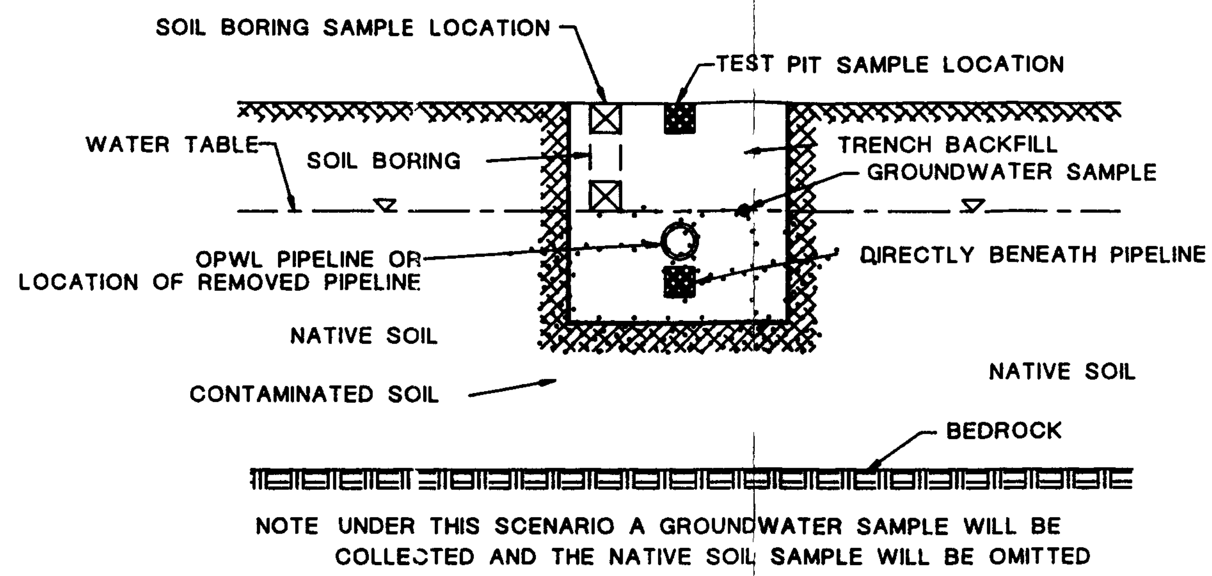
PREPARED FOR US DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado			
FIGURE 2 8			
TITLE CONCEPTUAL MODEL FLOW CHART FOR OU9			
PROJ. NO. 304908	DWG. NO. 304908-B67	SHEET	
DESIGN BY G Brand	CHECKED CJR	OF	
DRAWN BY KRONER	APPROVED CJR		
DATE 1-13-92	SCALE NA		

REV 1 GENERAL REVISION 3 6 92

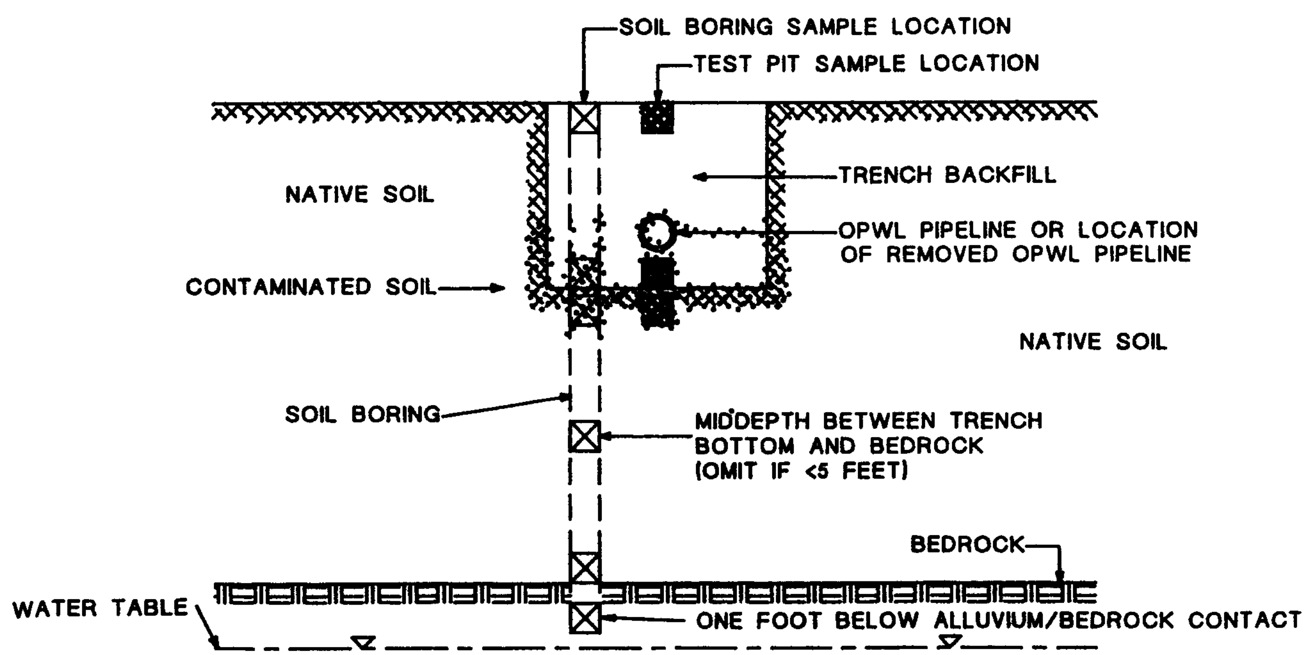
4908B67 03/06/92 3 33pm AWK



EXAMPLE 1 - WATER TABLE ABOVE BEDROCK



EXAMPLE 3 - WATER TABLE ABOVE OPWL PIPELINE



EXAMPLE 2 - WATER TABLE WITHIN BEDROCK

NOT TO SCALE

PREPARED FOR:
US DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

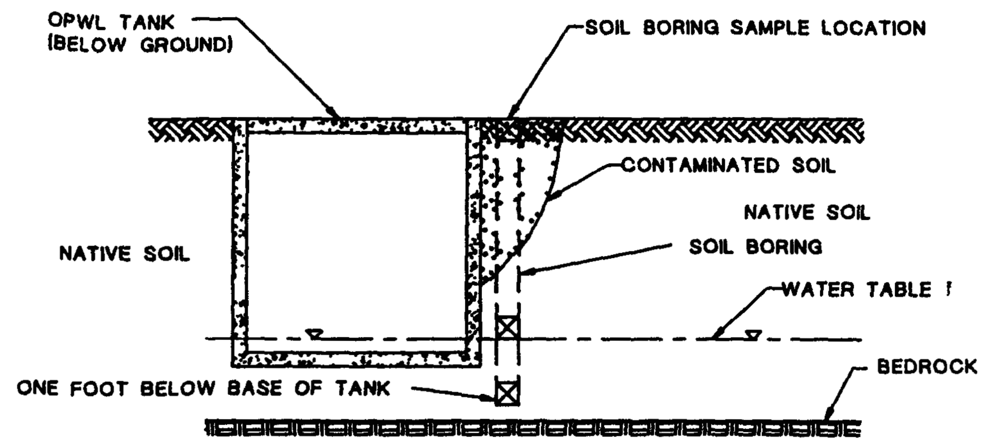
FIGURE 7 3

TITLE

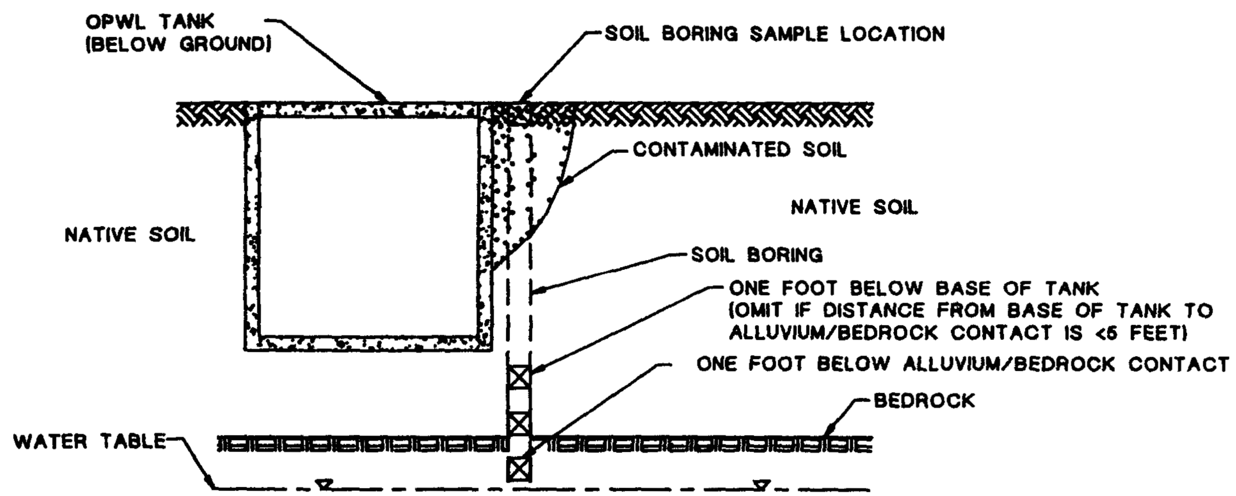
PIPELINE TEST PIT AND SOIL BORING SAMPLE LOCATIONS

PROJ. NO.	304908	DWG. NO.	4908-B130	SHEET
DESIGN BY	C CARNEY	CHECKED	CJR	OF
DRAWN BY	KRONER	APPROVED	CJR	
DATE	2-18-92	SCALE	NOTED	

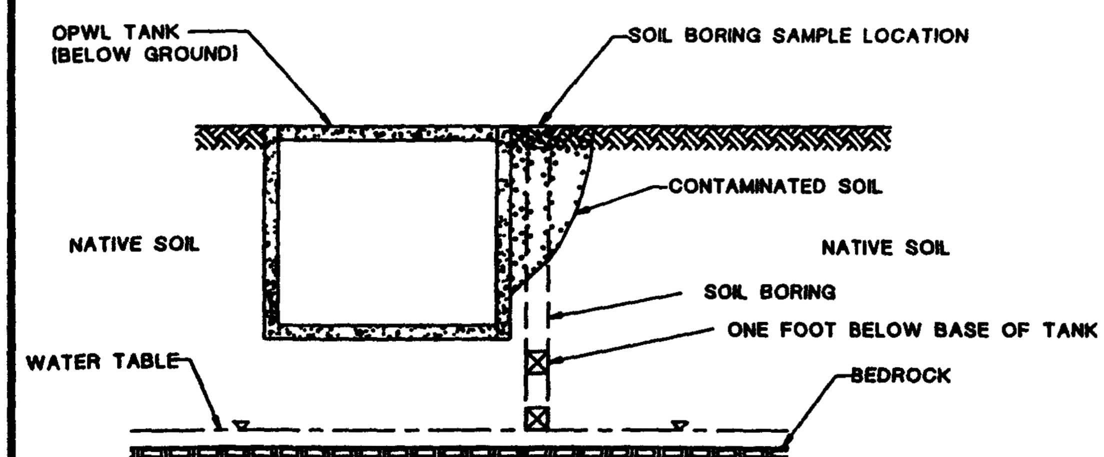
4908B130 03/10/92 10:02am AWK



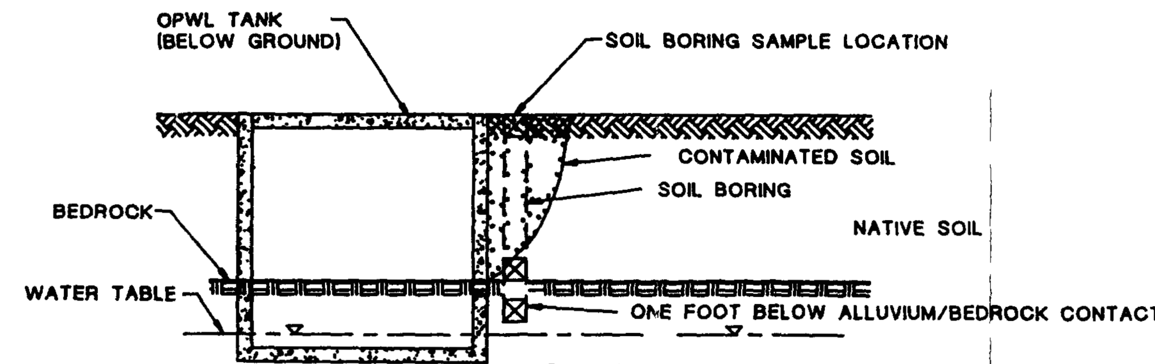
EXAMPLE 1 WATER TABLE ABOVE BASE OF TANK



EXAMPLE 2 WATER TABLE WITHIN BEDROCK

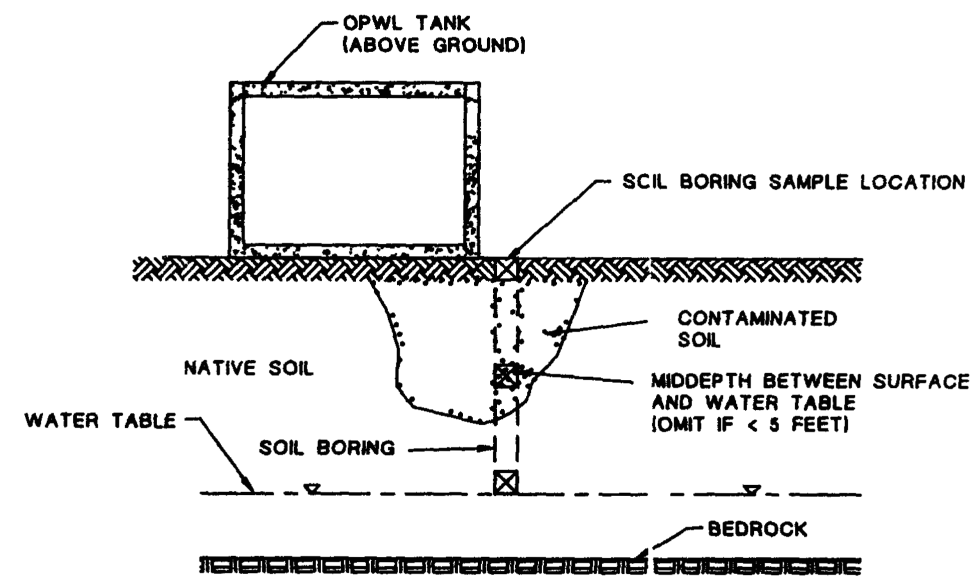


EXAMPLE 3 WATER TABLE ABOVE BEDROCK BUT BELOW BASE OF TANK



NOTE UNDER THIS SCENARIO (ie BEDROCK ENCOUNTERED ABOVE BASE OF TANK) SAMPLING BENEATH THE BASE OF TANK WILL BE OMITTED

EXAMPLE 4 WATER TABLE WITHIN BEDROCK AND TANK KEYED INTO BEDROCK



EXAMPLE 5 WATER TABLE ABOVE BEDROCK AND ABOVE GROUND OPWL TANK

NOT TO SCALE

NOTE IF TANK HAS BEEN REMOVED THE SOIL BORING WILL BE PLACED APPROXIMATELY IN THE CENTER OF THE ORIGINAL TANK LOCATION

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Golden, Colorado

FIGURE 7 6

TITLE **TANK SOIL SAMPLING LOCATIONS**

PROJ. NO.	304908	DWG. NO	4908-B131
DESIGN BY	C Carney	CHECKED	CJR
DRAWN BY	KRONER	APPROVED	CJR
DATE	2-18-92	SCALE	NOT TO SCALE

4908B131 03/10/92 1 27pm AWK